AMERICAN MACHINIST

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New Wood Pulping Engine.

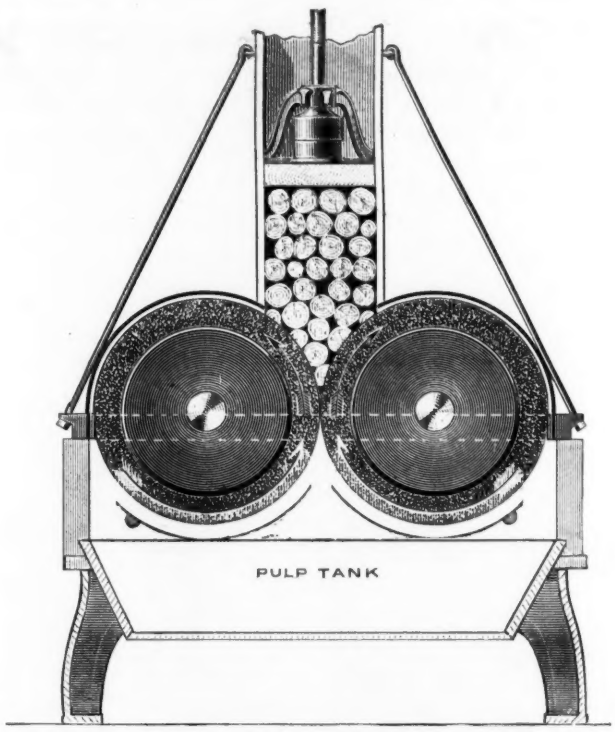
The manufacture of white paper for newspapers and books is largely aided by the supply of fibrilized pulp from wood. There are at present but few manufacturers of wood pulp in the United States, and the article has been consequeutly subject to excessive fluctuations in price. Within the past year a strong pressure has been brought to bear upon our national legislature to obtain a reduction in the tariff on wood pulp so as to prevent forcing high prices. Although but a trifling quantity of pulp is now imported, the advocates of a lower tariff claim that by adopting their measures the possibility of importing pulp at low prices will prevent any inordinate advances by those controlling the home supply. But the tariff was not changed, and the surest and safest way to secure reasonably low prices for pulp is to introduce machinery to grind it thoroughly and at the least possible expense. If the manufacturers of pulp are now enjoying anything of a monopoly there must be some inducement for others to enter the business. The wood pulping engine illustrated on this page presents an improvement over the common stone grinding system, not only by its rapidity of fibrilizing pulp, but by effecting a great saving of power. The latter consideration is of great value to paper makers who have no surplus water power. The preparation of the wood is simple and the product greater with less waste than with the older machines for pulping wood. This machine, therefore, opens up an effectual way to prevent arbitrary and unreasonable prices for wood pulp.

Part of its advantages arise from the peculiar construction of the grinding engine, which combines the most available process of concentrating power with the most economical method of preparing and holding the blocks of wood to be ground, and partly through the use of the Emery Fibrilizing Process, which controls the entire character of the fibrous pulp, making the same long or short as required for any grade of paper.

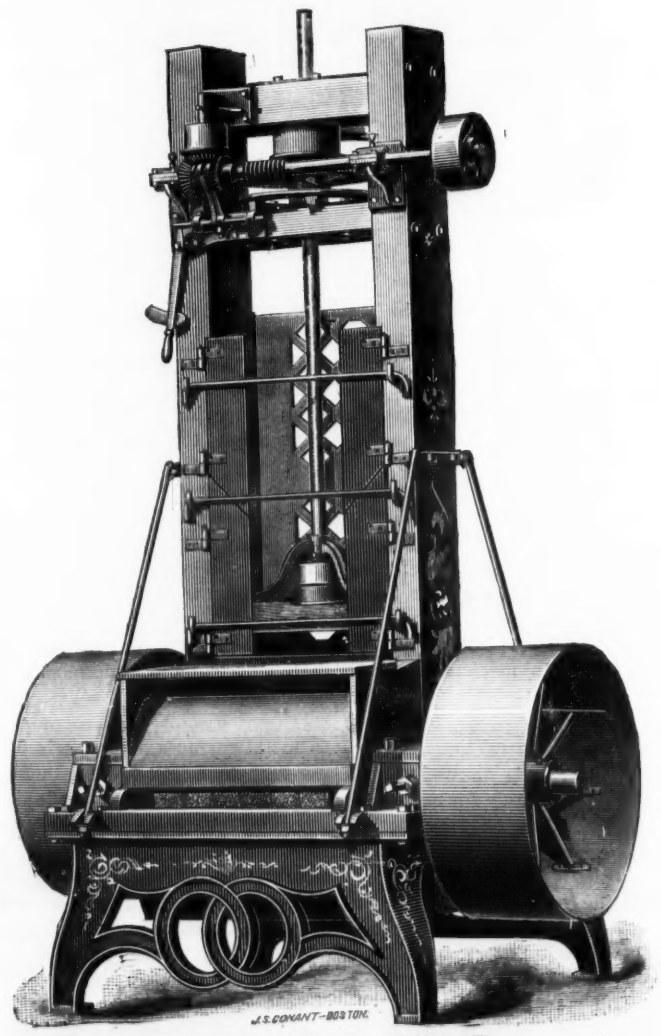
The emery process, it is claimed, has already revolutionized the wood pulp business by making a fibred instead of a floured pulp from wood, of any length required, thus enabling the paper-maker to concentrate the longest of the fibre in the center of the sheet, thereby producing a much smoother surface when calendered than when the flour of wood is used.

The wood is first cut in lengths of twenty-four inches, and of any size to suit the compass of the hopper, and when properly peeled and freed from knots, black sap or rot, is placed in the hopper, and by a simple, variable, automatic feed process, is pressed flat-wise, between the two outward revolving rolls, which are flooded with a spray of water, carrying off the fibrilized pulp in a stream, through screens to the wet machine, from which it is taken off in sheets; or, if preferred, the same may be conducted directly to the beating engine, where it is mixed with other stocks.

The machines are easily tended—one man tending four at the same time, after the wood is prepared; and each engine, with twenty-four inch rolls, at five hundred revolutions per minute, will produce between two and three thousand pounds of pulp (dry weight) in twenty-four hours, with from forty to fifty horse power, according to the character of the pulp desired, though two thousand pounds is the usual average amount produced in that time. The rolls or grinding cylinders are made of solid emery, and run in parallel lines, as near together as practicable; are water proof, and by regulating the length of corrugation thereon, will produce either long or short fibre, as desired, and often wear for years, without renewal or repair.



SECTION OF WOOD PULP GRINDER.



MACHINE FOR GRINDING WOOD PULP.

They can thus be set suitable for the preparation of any grade of paper desired, which object cannot be accomplished through the use of ordinary stone rolls.

Paper mills with surplus power can manufacture their own pulp, at a large saving, by these machines.

Nearly every kind of American woods can be utilized for the manufacture of wood pulp under this process, and when pure white wood cannot be had, a sub-bleaching process for dark wood can be added at a low cost.

These machines are known as the Allen & Jones Wood Pulping Engines, and are manufactured by the Empire Wood Pulp Company, Niagara Falls, N. Y.

Advantages of High Speed Engines.

BY CHARLES T. PORTER.

No. 14.

The subject of high speed in stationary engines occupies to-day, without doubt, the foremost place in engineering thought. The waters, once so calm and placid, are beginning to be disturbed. Of course, as on occasion of any departure from the accustomed order of things, prejudice and ignorance make haste to exhibit themselves, and in this case the cry of those who can give no better reason for doing anything than that it has customarily been done, is, that high speed engines must of necessity heat and pound and be subject to accident and soon wear out.

"Why, it stands to reason," said a prominent engineer; "Take a horse now, and put him to his speed, and keep him at it, how long can he last?"

Said an old man to me, "when you have lived as long as I have you will know more than you do now; you will find out that what you gain in speed you lose in power." He had got things mixed, and was talking about the driven arm instead of the driving arm of the lever.

"High speed," said an engineer of great eminence to me, "is all well enough if you only want an engine for a year or so. We had a customer who must have a high speed engine, and we made him one to make 200 revolutions a minute. He could pay for good work, and we made him as good an engine as could be made. It did pretty well for a while, but by and by one thing broke and then another, and then it all seemed to go to pieces together, like the deacon's one hoss shay."

The superintendent of a great establishment in New England, showed me a high speed engine he had, after some cramming on the subject, made for himself; and as I listened to the pounding and observed the stream of water playing on the crank-pin, he informed me that for his part he had got enough of high speed.

This all looks discouraging. Something more seems to be required than those parties were aware of.

A company of energetic business men have lately concluded, apparently, that what was wanted to make high speed a success was active and accomplished salesmen. The result is now in process of demonstration.

There is, however, such a thing as the science of high speed engineering. There

are mechanical laws that must be obeyed, uncompromising, as is all truth, exacting absolute conformity to their every requirement. All partial success depends on the degree in which, consciously or unconsciously, this obedience to eternal law is given. To the engineer, as to every *moral* being, comes the command, "be ye perfect," and then the reward, "behold all things are yours."

I ask no pardon for pointing out, in a single instance, the close analogy that holds everywhere between physical and spiritual truth. Both are from one source, both unseen and eternal. I bow before both with humility and reverence.

Throughout the works of the Creator, we are surrounded with illustrations of absolute mechanical truth.

From the mechanism of the universe to the structure of the minutest organism, never can the least error or imperfection be detected. I will limit myself to two illustrations: A body revolving unconfined must, by a necessity that is obvious when the forces come to be apprehended, revolve in perfect equilibrium about its center of gravity, and every system of bodies must in like manner revolve about their common center of gravity. In order that the flight of birds or insects shall be true, it is necessary that the wings on opposite sides of the body shall be right and left hand, and otherwise identical in area and form and position, and in the muscles by which they are actuated; and so they are always found to be, even to the shape of every feather, to the utmost limit to which, by the aid of the microscope our observation can be carried, and doubtless far beyond this.

Snow's New Water Wheel Governor.

In our issue of March 27th, 1880, we published a brief description of an improved water wheel governor, crediting its production, by inadvertence, to the parties from whom we obtained the information. We have since learned that the governor is the invention of H. D. Snow, and is made by the Cohoes Iron Foundry and Machine Co., Cohoes, N. Y. This week we again present the engraving, in designating some of its important features, as follows:

1. When in operation it brings the gate to the point which gives the required speed with a gradually decreased movement, and instead of continually hoisting and closing the gate, in the vain attempt to correct its own errors, it rapidly reaches the desired point and then remains inoperative, till a change in the weight to be carried demands a change in the height of the gate.

2. It is of sufficient strength to operate the gate of any of the various turbine wheels now in use.

3. Its durability is well assured.

4. Notwithstanding its great strength and durability, it is very compact—occupying upon its base but 18 inches by 29 inches, and in height but 31 inches.

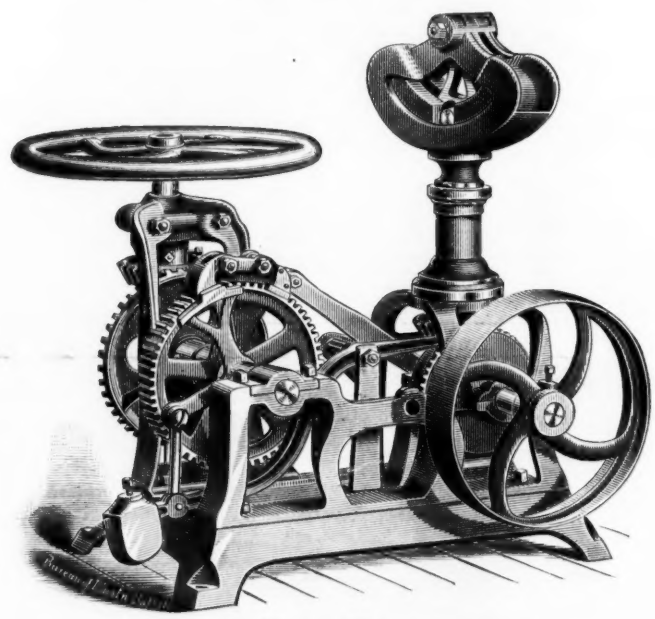
The Snow Governors have been in use now about fifteen years, in some of the largest as well as in the smallest establishments, and attached to all kinds of wheels, (even overshot and breast wheels), with heads varying from seven feet to seventy-eight, including the largest cotton mills in the world, in iron rolling mills, and down to one set woolen factories.

Engineering theory and practice have, for a long time, plainly pointed to high steam pressures as one of the surest ways to economy of fuel. Twenty-five years ago our ocean steamers carried only 16 lbs. pressure to the inch, and burned 5 to 6 lbs. of coal per hour per horse-power. To-day they are carrying 75 lbs. pressure, and burning 2½ to 3 lbs. of coal per hour per horse-power. In 1840 the Britannia, one of the finest steamers of the Cunard line plying between America and England, burned 5291 lbs. of coal for each ton of paying freight she carried, her speed, then considered fast, being 8½ knots per hour. In 1877 the Britannic, speed 15.6 knots per hour, burned only 551 lbs. of coal per ton of freight carried. Although our present steamers are making fast time and are very economical as compared with the earlier vessels, still it is a lamentable fact that on the largest and finest of them, furnished with all the latest improvements and best appliances to secure economy, worked by the most careful and intelligent engineers, we succeed in putting into our steam only about one-tenth of the heat realized in our boiler fire, the remaining nine-tenths of the heat being lost. Only in proportion as we make our steam hotter and expand it more, shall we economize in fuel. If a little bit of a boat, like the Anthracite, 84 feet long, 16 feet beam and 10 feet deep, can carry its own coal and water across the Atlantic, with a pressure of 350 to 500 lbs. to the inch, and on one pound of coal per horse-power, the natural inference is that our great steamers, when fitted on the same system will realize far better results. The change from three pounds of coal to one pound per horse-power means a saving of two-thirds in the coal bill, which is always an enormous item in the expense of large boats.

Friction of Lubricating Oils.

During the recent session of the American Association for the Advancement of Science, Mr. C. J. H. Woodbury read an interesting paper on Friction of Lubricating Oils, from which we make the following abstract:

The resistance existing between bodies of fixed matter moving with different velocities or directions, presents itself in the form of a passive force, which results in the diminution or destruction of opponent motion. Modern science has demonstrated that this destruction is only apparent, being merely the conversion of the force of the moving body into the oscillation of the resisting obstacle or into that molecular vibration which is recognized as heat. Direct friction refers to the case where the two bodies are in actual contact, and mediate friction where a film of lubricant is interposed between the surfaces, and it is this which applies to nearly every motion in mechanics where bodies slide upon each other. The coefficient of friction is the relation which the pressure upon moving surfaces bears to resistance. Mr. Woodbury limited his discussion to a description of the apparatus for measuring the friction of lubricating oils, the method of its use and the results obtained with a number of oils in the market which are used for lubricating spindles. Previous investigation of nine different oil-testing machines used, showed that none of them could yield consistent duplicate results in furnishing the coefficient of friction. The paper mentioned the circumstances which must be known or preserved constant—temperature, velocity, pressure, area of frictional surfaces, thickness of the film of oil between the surfaces, and the mechanical effect of the friction. The radiation of heat generated by friction must be reduced to a minimum, and no oil should be allowed to escape till subjected to attrition. Therefore, a dynamometer is required which is instantaneous and automatic in its action. The operation of the machine under equal conditions with the same oil gives results which are as closely consistent with each other as could be expected from such physical measurements. Much of the slight irregularity was due to the variable speed of the engine. The results were remarkably uniform, but they do not agree with the laws of friction, as given in works on mechanics, but the coefficient of friction varies in an inverse ratio with the pressure. Friction varies as the area, because the adhesiveness of the lubricant is proportional to the area, and the resistance due to this cause is a larger fraction of the total mechanical effect with light than with heavy pressures. The lubricant used is one of the most important factors in the cost of power. In the present condition of engineering science it is impossible to state what exact proportion of the power used by a mill is lost in sliding friction, but in a print-cloth mill only about 25 per cent. of the power is utilized in the actual processes of carding, spinning and weaving the fibre, not including the machinery engaged in the operation, leaving 75 per cent. of the power absorbed by the rigidity of the belts, the resistance of the air and friction. The successful operation of a spinning frame is far more closely dependent upon the individual management in respect to the conditions of band-tension, lubrication and temperature of the spinning-room, than all other causes combined. Not that some forms of spindle are not superior to others, but without wise supervision the most desirable forms of spindle must fail to show the merits due to the skill of their promoter.



Snow's New Water Wheel Governor.

The lubricating qualities of an oil are inversely proportional to its viscosity; the endurance of a lubricant is, in some degree, proportional to its adhesion to the surfaces forming the journal. An ideal lubricant, in these respects, would be a fluid whose molecules had a minimum cohesion for each other, and a maximum adhesion for metallic surfaces. Viscous oils adhere more strongly to metal surfaces, hence it is obligatory to use such thick lubricants on heavy bearings. With light pressures more fluid oils are admissible, and in all cases the oils should be as limpid as possible. Oils with great endurance are likely to give great frictional resistance, and in the endeavor to save gallons of oil, many a manager has wasted tons of coal. The true solution of the problem of lubricating machinery is to ascertain the consumption of oil and the expenditure of power, both being measured by the same unit, namely, dollars. Mr. Woodbury detailed his experiments in measuring the fluidity of oils; omitted their endurance, because consumption of oil varies with temperature, and gave the data for determining the safety and efficiency of a lubricant.

Great pains had been taken to procure pure samples of the oils experimented with. The lard and mineral oils were procured directly from the manufacturers as given subsequently; and Thomas Bennett, jun., procured a large number of samples of sperm oils directly from the whale-ships or refiners. The following table gives the co-efficient of friction at 100° and five hundred revolutions; also, the results of some chemical examinations of these oils by Mrs. Ellen H. Richards, of the Women's Laboratory, Institute of Technology:

Resistance of Friction at 100 Degrees.

No. of Sample.	Kind of Oil.	Co-efficient of Friction at 100 Degrees.
28	Downer Oil Company, Champion.....	.1732
10	Downer Oil Company, Heavy spindle ..	.1187
14	Downer Oil Company, Heavy spindle ..	.1233
19	Downer Oil Company, Heavy spindle ..	.1208
7	Downer Oil Company, Light spindle....	.1113
20	Downer Oil Company, Light spindle....	.1132
8	Downer Oil Company, 32, extra machinery.....	.0756
2	Leonard & Ellis Valvoline spindle	.1476
11	Leonard & Ellis White Valvoline spindle	.1493
12	Leonard & Ellis Valvoline White loom.	.1201
15	Leonard & Ellis Valvoline machinery..	.2243
13	Olney Brothers, German spindle.....	.1190
16	Olney Brothers, A spindle.....	.1103
3	John P. Squire, Lard.....	.2181
4	Bleached winter sperm A.....	.1067
5	Bleached winter sperm B.....	.1217
6	Bleached winter sperm C	.1170
9	Aiken & Swift, Bleached winter sperm	.0956
17	Aiken & Swift, Unbleached winter do.	.1147
18	Aiken & Swift, Bleached winter sperm.	.1141
21	Seal Oil.....	.1608
22	Alexander Boyd & Sons, Neatsfoot.....	.2427

	Flash of Vapor Fahrenheit.	Loss by Evaporation in 10 hours at 140 Degrees.	Nitro-Sulphuric Acid Test.
	Degrees.	Per cent.	
10	338	1.3	Dark yellow, with much cake.
7	314	2.7	Dark yellow, some cake.
8	284	5.5	Slightly yellow, only a few flakes of cake.
2	316	3.7	Dark yellow, very thin layer cake.
11	324	3.9	Slightly yellow, not one brown speck.
12	318	3.3	Yellow, not a single flake, no solid matter.
15	286	7.2	Turned dark, gives a black layer of gum.
13	282	5.0	Quite an amount of cake.
3		+0.4	Hardened with much acid to a white solid mass.
9		+0.3	Thicken up a little like jelly.

With castor oil, the friction was so great as to throw off the belt driving the machine; and, as the time allotted for this work was at an end on that day, other arrangements for a wider belt could not be made, and it can only be said that its friction is much larger than that of any oil given in these tables.

A portion of a lot of unbleached sperm oil (sample 17) was bleached expressly for these tests (sample 18), but the results are so nearly uniform as to be practically identical. The result of bleaching does not affect the anti-frictional properties of the oil, although it undoubtedly reduces its gumming qualities.

The friction of sperm oil is subject to sudden variations which occur at certain temperatures, for the same sample of oil. The explanation of this lies in the fact that sperm oil consists of a large number of varieties of spermaceti, each of which is liquefied at certain temperatures, at which the oil is relieved of waxy or, at least, gelatinous particles, and becomes a more perfect lubricant.

Letters from Practical Men.

THE BREAKING OF WATCH SPRINGS.

Editor American Machinist:

Sir: In your issue of Sept. 11th you have a quotation from the *Jewelers' Journal* in regard to the breaking of watch main-springs, supposed to be due to electrical changes in the atmosphere.

During an experience of some six years as "overseer" of a watch-rack averaging in number about 125 watches, of the better and best grades, the phenomena referred to were very frequently noticed, in fact it was a matter of *expectancy* that a heavy thunder-shower, with much electrical activity, was a sure forerunner of a *harvest* in main-springs; for it was one of the best paying jobs in the business. The finer grades of Swiss and American watches were not so subject to "weather

breaks" as the commoner grades, owing, doubtless, to their better temper and material, and to their proportions, as fine springs average very thin in comparison to their width, and a thin spring in a small barrel will, invariably, last longer than a thick spring.

Another frequent cause of main-spring breaks, that is not generally known as well as it should be, is the removal of the main-spring from its barrel when repairing the watch for the purpose of cleaning the spring by wiping or stripping it through a cloth or chamois skin; and then replacing the spring in its proper position. This, though often done with *the best of intentions*, is a very frequent cause of breakage. The spring may not break immediately, but, as an almost invariable rule, break it will within a few days or weeks.

The cause of this is doubtless owing to the long compressed condition of the spring, during which time it became, in a sense, crystalized to its shape, and when relieved and straightened is like a piece of bark treated in a similar manner, viz: filled with small but innumerable "skin" fractures across its breadth, that ultimately result in a complete separation at the weakest part.

And yet the whole story about steel springs is not told. Respectfully Yours,

JOHN THOMSON,

9 Spruce St., New York.

TENSION AND ADHESION OF BELTS.

Editor American Machinist:

A friend of mine, who is neither machinist nor has any experience with belting, submitted to me the following questions bearing on the belt discussion:

Suppose we have a 2-inch belt running over a 12-inch pulley, tension 200 lbs., transmitting at a certain speed ¼ horse power. *First.* Will the same belt with the tension increased to 400 lbs. be capable of transmitting double the power? *Second.* How much power will be transmitted by a 4-inch belt of 400 lbs. tension when running at the same speed and over the same sized pulleys? *Third.* Is not a 4-inch belt at 400 lbs. tension equal to two 2-inch belts at 200 lbs. tension each?

I respectfully submit these questions to Mr. Rose for an answer. Unless he chooses to answer the last question negatively, he will have to admit one of two things; either that a belt at double tension is *not* capable of transmitting double power, or that the "important omission" (adhesion) is not very important after all, and that a 4-inch belt pulls no more than a 2-inch belt provided both have the same tension.

Allow me to add that the influence of the arc of contact upon the effectiveness (friction) of the belt is so well settled that the formula can be found in any complete book on mechanics, and it is only surprising if a mechanical engineer attempts to re-open the question. Yours truly,

440 N. 12th St., HUGO BILGRAM.
Philadelphia, Pa.

A BELTING ARGUMENT.

Editor American Machinist:

I was pleasantly surprised by a visit from my old friend Mr. C. O. Sine, who was taking a holiday, and called, as he said, "to have a chat on anything mechanical." Now "Coe" is one of those good-natured fellows who have no mechanical secrets, and will as readily impart as receive information. He suggested that the AMERICAN MACHINIST would furnish "food for reflection." I handed him a few of the last issues that he might make a selection. It was not long till we found we had widely different opinions concerning the transmission of power by belting, and to arrive at a conclusion, if possible, we argued the points of difference *pro* and *con*. It was *Con's* conviction that a partial vacuum existed between the face of the pulley and belt; he justified his opinion as follows:

"In building engines, care is taken that the bearings are made as smooth and cylindrical as possible, that friction may be reduced to the minimum, and satisfactory running of the machine be the result. Now the same course is pursued in making a pulley. It is turned true and smooth, and it is generally supposed, I believe, that by this means the friction is increased to its maximum; perfection of surface is sought in each case, but for opposite purposes. There can be no doubt that a true, smooth journal turns easier than a rough one, and for this cause a belt *ought* to slip with less strain on a smooth pulley than a rough one, but it don't, and the reason is that a partial vacuum exists between surfaces in contact. The nearer the surfaces conform to each other the more perfect the vacuum, and vice versa; hence, besides the friction due to the tension of the belt, there are a few pounds of atmosphere "hugging" the belt to a smooth pulley—a condition of affairs which would not exist if a rough pulley were used. I have an idea that if two surfaces were placed in a vacuum and experimented with, it would be found that theory and practice would go hand in hand; but as long as the surfaces are outdoors, the weight of the atmosphere has something to do with the amount of surface in contact, while friction, *per se*, has nothing whatever to do with it."

Con delivered his views with much earnestness, and intended to carry conviction with them; but still *Pro* stuck to his views, which might be called the theoretical side of the question, but he "opened up for the defense" with little hope of making an impression.

"If your views are true, *Con*, in this matter, how can it be possible that a belt will slip on a large pulley, which is often the case, especially if the large pulley be the driver?"

Con. "I know that belts will slip on the large pulley, and that goes a long way towards proving that friction is independent of the surfaces in contact, even when they are outdoors; but the phenomenon can be explained as still being due to the weight of the atmosphere. To illustrate: Take a driver having 400 square inches of its surface covered by the belt, a driven pulley having 200 square inches covered, and the tension of the belt is 1,000 pounds. It will be seen that the pressure per square inch on the driver caused by tension will be 2½ pounds, while on the driven it will be 5 pounds. For this reason the contact will be much greater on the driven than driver, and it is only reasonable to suppose that the unbalanced weight of the atmosphere on the driver is 2½ pounds per square inch, while that on the driven is 5 pounds, thus neutralizing the difference of surfaces in contact."

Pro. "Your theorizing is O K so far as it goes, but an idea has just struck me that leather is not vacuum proof. At any rate I am going to test it at the first opportunity I get meanwhile."

Con. "Suppose I were to take a piece of a belt in good running order and place it between two surface plates, give it a moderate pressure for a few minutes, then lift the top plate—would the lower one follow?"

A "loud silence" followed the question for a few minutes.

Con. "I don't think it would, because the belt would be worn to a surface on but one side."

Pro. "I don't think it would, even if both sides were carefully surfaced, because the material is too porous. The space between the leather and the plates is so small that a particle of air would destroy a vacuum if it ever existed. Since thinking the matter over, I remember an old blast engine that I used to be called on, occasionally, to 'doctor.' The 'blowing tube' of that engine was liberally lubricated, and, in consequence, the double leather valves in a short time got well saturated with oil; and when there was a few pounds pressure on the valves, the oil could be plainly seen coming through the leather, and of course the air followed. True, the loss of air was practically nothing, but still it was sufficient to destroy a contact vacuum. Rubber belting would not admit air through it, but the surface of a rubber belt is so rough that a joint could not be made unless it were bolted to the pulley, the ordinary strain of the belt being insufficient."

A few questions were then asked by *Con*, that he might be armed for an argument in the future. "Has the width of a belt anything to do with the power to be transmitted?"

Pro. "Not so long as the pull don't exceed the strength of the belt."

Con. "Has the number of degrees of pulley covered by belt anything to do with the transmitting power of belt?"

Pro. "No."

Con. "Does it make any difference which is the slack side of a belt (top or bottom), as regards its transmitting power?"

Pro. "Not any."

Yours truly,

Youngstown, O. J. H. DUNBAR.

Editor American Machinist:

Some time since I noticed an interesting incident in connection with the subject I sent you a communication upon last week. There are certain machines driven by vertical belting, arranged to run idle until brought into contact with lower pulley, by means of a tightening pulley pressed against the belt. In starting the machine here referred to, the belt was thrown on to the upper pulley; but instead of moving with the pulley, the belt hung at rest and the pulley revolved inside of it. I simply noticed the fact, but thought nothing of it until the machine had been started by using the tightener. When the tightener was thrown back, the belt moved with the upper pulley. My attention was at once drawn to the matter, and after throwing the belt off and on the upper pulley several times and noting the result, I was satisfied that sufficient air was caught in the upper curve of the belt to hold it off the pulley, and thus prevent it moving with the pulley. Every time the experiment was tried, the belt moved with the upper pulley after the tightener had been brought hard up to the belt, and then thrown back, thus forcing the air out from between belt and pulley.

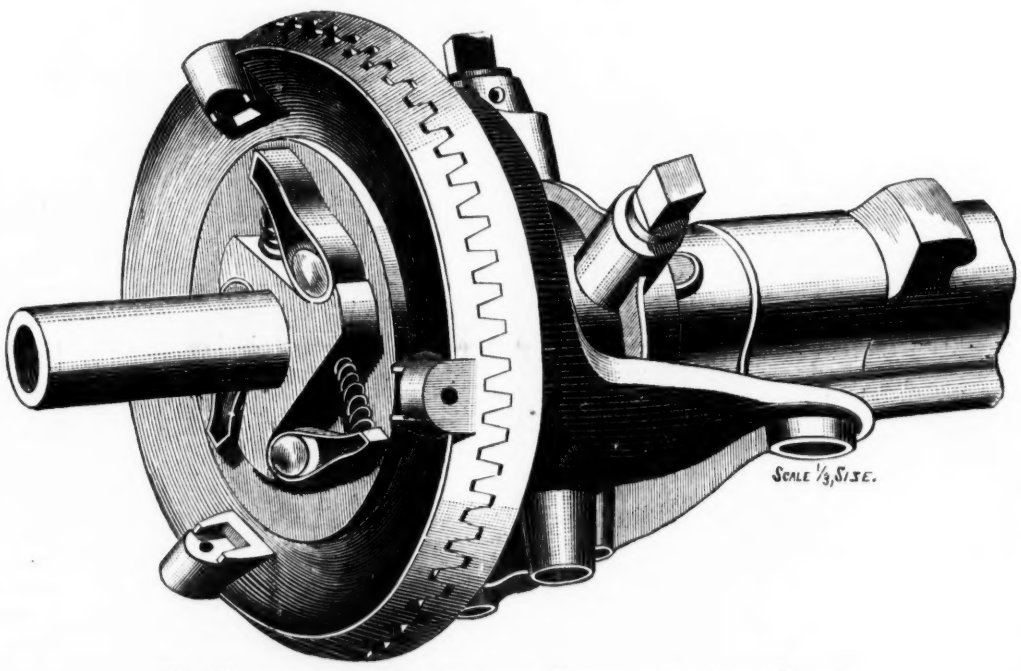
To prevent "confusion," it will be well to remark that the belt was slack enough to be lifted on to the upper pulley quite easily, instead of "running" it on as usual. Ordinarily a belt is sufficiently tight to force out the air at once when it is thrown on.

Yours truly,

CHAS. A. HAGUE,
Chicago, Ill.

New Reciprocating Motion on Champion Mower.

The manufacture of agricultural machinery is one of the most progressive and important iron working industries of our country. Besides supplying the farmers within our national boundaries, agricultural implement manufacturers, both West and East, are carrying on a large and growing export trade to almost all civilized countries of the world. The American mowing machine is far ahead of any foreign competitor, and improvements are yet being made. The manufacture of Champion Mowers and Reapers alone keeps in regular operation five immense works in Springfield, O., and one in Toronto, Ont., which require additions to their productive capacity every year, owing to the enormous demand. On this page we present a cut, showing the new mechanism used for propelling the knife in the New Champion Mower. Only one pair of gear wheels are used; eleven cogs are always in contact, instead of three or four cogs, as in the case of the ordinary bevel wheel and pinon, thus distributing the wear over a much larger surface, and proportionately reducing the strain friction and consequent wear upon each. By means of this movement, and other excellent devices, the machine runs almost noiselessly, and with extraordinary smoothness.



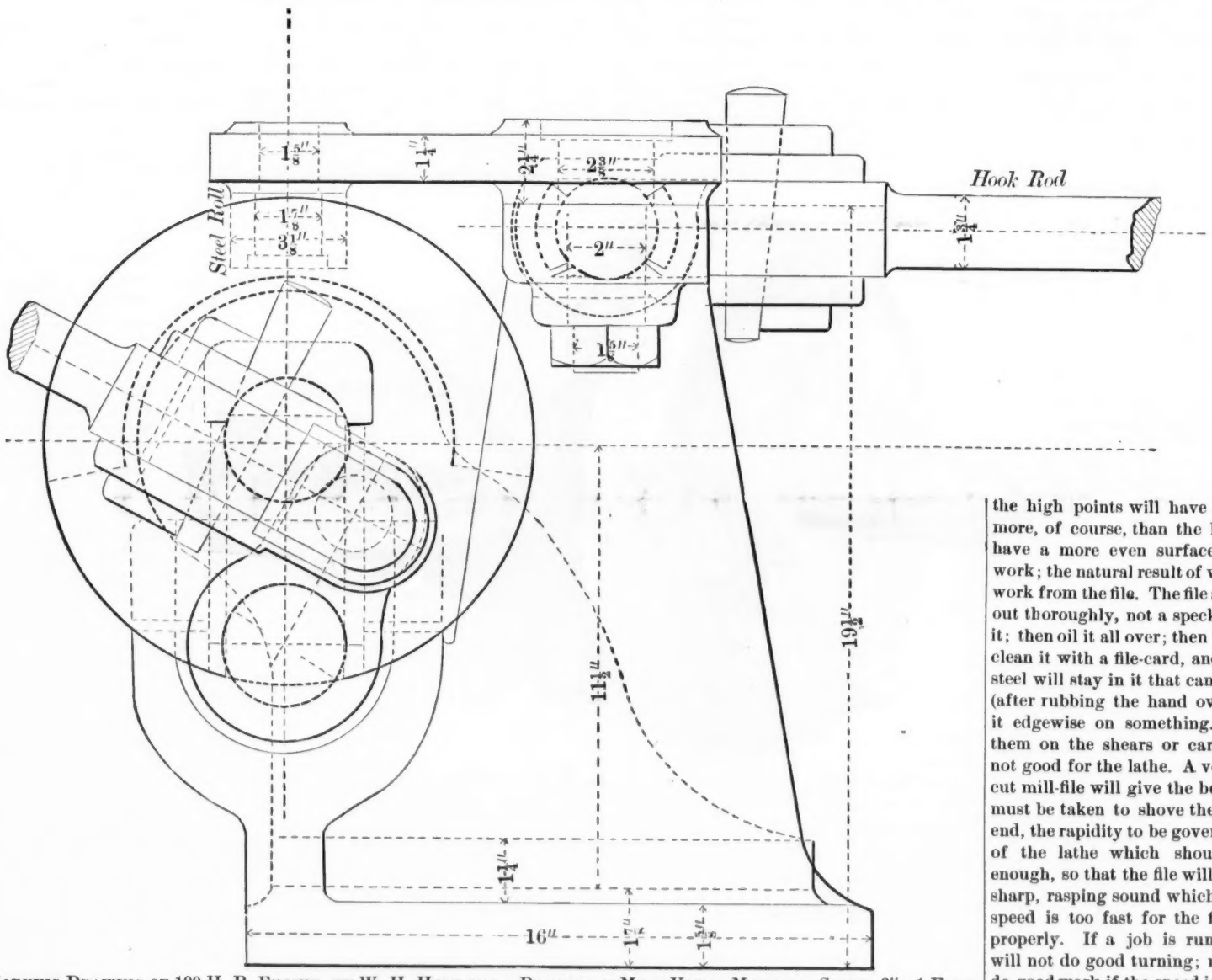
NEW MECHANISM FOR RECIPROCATING MOTION ON CHAMPION MOWER.

The "Champion interest" gives exclusive employment to about twenty-five hundred workmen in the shops. These five establishments at Springfield, O., are as follows: Whiteley, Fassler & Kelley, Champion Machine Co., Warder, Mitchell & Co, Champion Malleable Iron Co., and Champion Bar and Knife Co.

Twenty years ago, says the *Graphic*, the steamer John Neilsen ran through the Kill von Kill at the rate of twenty-five miles per hour. This great speed was accomplished by means of two engines pumping air under the hull, which gave her a great buoyancy. The paddles did the rest. But she raised a terrible commotion in the waters of the Kill. Her swell dashed small boats ashore and washed over the piers. The oystermen who rendezvous in this vicinity complained, alleging that her swash injured their oyster beds as well as boats. The Neilsen then adopted a sort of drag to keep her own swell down. The expense of running the boat on this plan proved too great. She was converted into an excursion barge, and the fastest boat which ever ran in New York waters now lumbers heavily after a tug. Cannot steamboat men, re-applying this system of forcing air under the hull, lifting it out of the water, and thus diminishing the friction with a greater economy of fuel, put the Anthracite's idea of saving fuel and the hull air pumps in operation together, and twenty-five miles an hour will be more cheaply realized?

Working Drawings of a 100 H. P. Engine.—Details of Main Valve Motion.

The accompanying drawing represents main valve motion in detail of the 100 H.P. engine, of which other working drawings have been presented in our pages. This is a side elevation, showing eccentric as connected to bell crank shaft, swinging in its bearing and transmitting motion to the wrist cam-plate, by means of pin and sliding gear metal block. The block moves in a slot prepared for it in face of wrist-plate cam. On the edge of the cam is a spiral slot, in which is fitted a steel roller, the roller being directly attached to main hook rod arm. It will be seen that by this motion the travel of valve is, on the average, up to the point of wide open, three times as fast as the ordinary eccentric motion when directly connected, and at the beginning of the opening, its travel or motion is nearly five times faster than the regular eccentric motion.



WORKING DRAWING OF 100 H. P. ENGINE, BY W. H. HOFFMAN.—DETAILS OF MAIN VALVE MOTION.—SCALE, 3″=1 FOOT.

The advantages of this motion will be readily understood, as both the steam and exhaust sides of main valve get a full port early in the stroke of piston; when open, they remain so, during the remainder of the travel, as the roll is carried into a slot or groove, parallel with the face of cam, thus suspending motion for the time.

Finishing in a Lathe Practically Considered.

BY H. B. GATES.

In your issue of August 28th, Chordal winds up with the wish that some smart lathesman would write a letter to your paper on the subject, "who not only knows how to tell about finishing, but knows how to do it."

The writer is a machinist of some experience as a lathesman, and has often noticed this failing in good workmen, viz., not understanding the art of finishing work quickly and well. I will give those interested the benefit of some thoughts upon the subject which have presented themselves to me at different times in my experience as a lathesman, in a plain, practical way.

I will assume that the material to be turned and polished is of the best quality, for, of course, the better the material, the better the finish will be; also, that the lathe is first-class, as the turning is a very essential point in making a good, quick finish and true work. If the lathe is faulty, the job may be made to look well, but will not stand the test of calipers in expert hands for soundness. Where there is an ordinary amount of metal to be turned off a job, three cuts are necessary for true work, the first, a heavy one, to take off the rough. After this cut it will be found that the work will not be round, but will have ridges and hollows corresponding with those on the forging, only not so noticeable.

For the next cut, pains should be taken to have a tool very sharp and slightly flat at the cutting point, in order to turn smooth, and leave but $\frac{1}{64}$th of an inch for the finishing cut. It will at once be seen that the second cut must be a smooth one, or the last one will leave the face marks of the second, as the calipers take the largest part or the top of the face mark or thread.

For the last cut, we want a very sharp tool; what I mean by that is it must have a thin cutting edge, and well up to or above the center, according to the size of the work, in order that it will have very little clearance so that it will cut, not scrape, the metal off. It is well known that in whittling with a knife, the flatter the blade lies down to the wood, the smoother and easier it will cut. I try as far as possible to carry out this principle in turning metals.

If the metal to be turned is steel, run the lathe very slowly with a *fast* feed, and have the flat cutting point of the tool just a little wider than the feed will be. Set the tool so that the right hand side of the cutting edge will barely touch the work as the tool runs along. This will prevent (if care has been taken in setting the tool) leaving tool marks in the work, as the left side of the tool will do the bulk of the cutting, and the flat part tool is $\frac{1}{2}$″ or $\frac{3}{4}$″ back from where it was cutting before, and gradually feed up the tool to the work, until it just scrapes, and it will be found when it comes to the cut (if properly set) no mark will be left, as there is not cut enough to spring the work or the tool rest.

Some may say time is lost in taking out and sharpening tools, but if practiced, it will be found to shorten the time of filing wonderfully, as in running a tool the length of a steel rod without changing, the last end will get very rough, and will look as though a thread had been cut upon it. Now the calipers must be used to keep the work straight, and the rougher the work gets towards the end, the more allowance must be made for filing, as the part last turned will take more filing to get smooth than the first part. If the right allowance has not been made when the tool marks are filed out, it will not be straight, owing to having filed more at one end than the other to get out the deep marks. Then it must be filed more on the end that was first turned, in order to get it down to the size of the other end. After this is done, the rod is full of scratches and out of round, which would not have been if there had been less filing done; and ten to one, that the lathesman has by this time, got out of patience with himself and everyone else, and slashed into it with a coarse file. After that, the polishing becomes a question of time. Therefore, give more attention to turning in order to save time in polishing and have true work.

However, we will suppose the work is turned and ready to finish, the first move is, of course, filing. Here a word about the file. A new file never should be used on a job that is to be polished, for I have yet to find a file that is not uneven; that is, some teeth will be longer than others, and the longer ones will tear a chunk of metal from the work, which will remain in the file, and every time it goes over the work will leave a scratch if it is not instantly picked out. Besides, a new file will chatter on the work almost invariably. Therefore, a partly-used file is better to use, as after it is used a while the high points will have been worn down more, of course, than the low ones, and we have a more even surface to apply to the work; the natural result of which is smoother work from the file. The file should be cleaned out thoroughly, not a speck must be left in it; then oil it all over; then wipe it clean, and clean it with a file-card, and no particles of steel will stay in it that cannot be jarred out (after rubbing the hand over it) by rapping it edgewise on something. Some men rap them on the shears or carriage, but this is not good for the lathe. A very fine and even cut mill-file will give the best results. Pains must be taken to shove the file from end to end, the rapidity to be governed by the speed of the lathe which should be just fast enough, so that the file will cut without that sharp, rasping sound which shows that the speed is too fast for the file to do its work properly. If a job is run too fast, a tool will not do good turning; neither will a file do good work if the speed is too fast, as both file and tool cut upon the same principle. The file shows hundreds of cutting edges similar to the cutting point of the tool. Therefore, to save the file and make a good surface to polish, have an eye to the speed. When the file is right and the speed is right, there is no difficulty in filing the work, so that it may be easily and quickly polished. Work should be filed only just enough to take out the marks of the tool. When the job is iron, filing is hardly ever necessary, unless the iron is gritty and coarse, when it is impossible to turn smooth enough to polish.

Now I come to the polish, which is the most difficult part of the job. In the first place, the emery clamps are a dead failure, so far as finishing nicely is concerned, because unless of very soft, white pine, they are too hard, and if anything else, especially coarse-grained wood, they will scratch and grind in ridges, on account of the wood being softer and more porous between the grain than the grain itself, while the emery will pack in the soft part and remain there, and the hard part will have no emery on after showing the clean grain of the wood when taken from the work. If the

clamps are held in one position with the work running, they will cut "rings," and if they are drawn from one end to the other, they will cut a "screw:" besides, they are everybody's tool in the shop, and lie around without cleaning. Dirt and chips are swept over them and they are filled with grit, while every man who uses them wants a different sized emery, consequently they are never fit for any one to use, except on some rough job for a country saw-mill, and not worth much for that, except in a way that I will attempt to explain.

Clamps will answer to give the first finish, but should never be used without a soft and heavy piece of sole leather or rubber being tacked on to each clamp. If rubber, use emery cloth; if leather, use emery loose. Nailing a piece of leather on the ends for the hinge will prevent pinching one side of the clamp harder than the other, as will be the case on account of the pieces not being put together true. In the case of leather clamps, use emery that will correspond to No. ½ emery paper. Oil the rod, also the leather, and sprinkle the emery on the leather evenly. Apply the clamps to the work, and draw from one end to the other slowly at first, and just long enough to letter out the marks of the file. Then draw from one end of the work to the other more quickly a few times and stop. Then take the finest emery cloth, and use that in the hands; because, for a finish the hand will accommodate itself to the work better than anything else.

Now, before using the cloth, if it is examined, it will be found that there are ridges in it that are caused by the uneven texture of the cloth, same as ridges in the file caused by uneven cutting. The same defect will show on the work to a less extent, when applied to the work. This difficulty can be overcome by taking two sheets and rubbing them together on a smooth board, making the surface more even by wearing off the ridges. It will not cut so short however, nor is it necessary to have it, as we have previously used a medium-sized emery, and the work has a fair finish, but the scratches are very much disarranged, owing to the movement of the clamps from end to end of the work quickly.

Therefore, what we want to do is to take out the disarranged scratches with the fine emery cloth. Owing to this disarrangement, it can easily be told when they are all out, after using the fine emery cloth with oil. If pains have been taken all through, this will give a very good finish.

If the work is such that it requires a finer finish, then draw the cloth from end to end more quickly, in order to again disarrange the scratches. Apply some one of the next finer and less sharp polishing materials, on a well oiled soft piece of leather (chamois skin is best) in the hands, and treat the work the same as with the fine emery cloth, when the scratches again become uniform. It naturally follows that those left by the emery are all out of the work, for if they are not, they can readily be seen with the eye. If the work is to be still finer, leave the scratches disarranged as before, and apply some still finer polishing material on *another* piece of chamois skin, and so on down, almost indefinitely.

When we get this far, it is presumable that the job is good enough for all practical purposes, and will be a good smooth finished surface, not a "high polish and deep scratches." It needs no dry polishing, produced by "flour of emery and cotton waste," simply wipe clean, and, while running, but apply a clean chamois skin for a few minutes, and the polish will be there, as a matter of course.

Chordal is partly right and partly wrong about the cost of finishing. It certainly costs more to finish work fine than rough. If it does not, then the workman is not doing his duty on the rough work, for it does not take as long to rub the tool marks out of a piece of work with a coarse file, and apply the emery with clamps until it looks bright and finished, as it does to make a dead smooth polished surface. But, I must admit, that the difference is vastly in favor of the fine finish, when taking into question the difference in the quality of work. If the workman has been careful in the manipulation of his job, the cost has been but a trifle more than a coarse finish would be. But if workmen gave the attention to work that is to be finished that it requires, it could be done very much finer than it is, and, for the same or less money, with the same machinery and materials now in use in every shop. It is not the fault of the material that is to be polished, or the materials that are used in polishing, that we do not get finer looking work, but simply a want of care and thought upon the part of the workman. To bring a polish down to appear to the eye like "nickel-plated" work, to place upon exhibition, or for scientific purposes, of course costs more money, as time, great care and neatness in manipulating only will produce such a result.

In the process I have described for finishing a piece of work, the turning has taken no longer than is taken in ordinary cases. The filing and detailed operations of finishing have not taken as long, but there has been more of polishing material applied, so that the job when finished will have taken a little longer time.

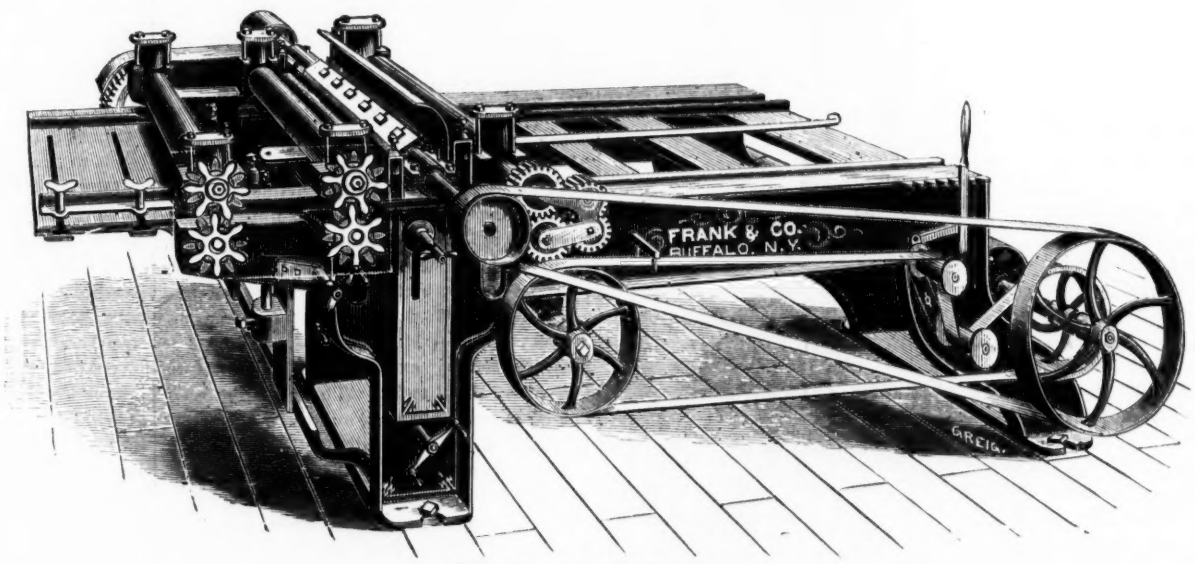
What a glorious sight a nicely finished piece of work is when nicely wiped off and taken out of the lathe and placed where it cannot get marked! If a job of my own, I admire it with satisfaction, which, to an extent, pays me for my time and trouble. If some one else has done it, I look at it with a feeling of profound admiration, and it will thereafter be my aim to do as well and better if I can. I will here remark that no man can finish a job well unless he has a sprinkling of pride in his work after it is done. But, if he has this pride in his work, with a disposition to excel, and ambition enough to take pains with his tools, there will be no difficulty in his doing good work, if he simply *thinks*. Want of ambition and pride in mechanics is a great failing.

There are many good workmen who do not care what anyone thinks of their work, or how it looks, as far as finish is concerned, so long as they are not expressly ordered to give it a fine finish. They can turn well, fit their work to a nicety, the corners will look square and neat, and, in fact, their work will look mechanical. They commence to polish, when the job is spoiled *for beauty*, almost instantly, by the use of emery clamps or a straight stick with emery and oil on the end of it. The stick is placed on a rest with one end under the work, and the other end under the arm to save holding it with the hands, thus throwing the whole weight of the body on the stick to rest easy, while the lathesman is having a talk with a shopmate about something far from the business in hand. When he gets through with this conversation, and looks at his work, it is horrible—cut full of deep rings, corners ground off (if there were any), but it looks bright, and he wipes it off with the remark, "it's good enough," and down it goes on the floor to be walked over, swept over, and, perhaps, rolled around for a day or two, until the gang boss (who has charge of the engine, to which it belongs), sends a helper after it, and it goes on the truck. It makes no difference whether the truck is iron or not, there is nothing put under it, and it is bumped over the floor the length of the shop, if it does not fall off. By the time it gets to the gang it has many "private marks" that will never come out, and it is brushed up and put in its place, looking as if it might pass for repaired work. Who, (that knows anything of a machine shop,) can say that this is exaggerated? The fact is, the gang boss has no more pride and ambition to keep the work looking nice than the lathesman. This is one reason why we are not getting better finished work in the common run of shops. There is a demand for the work, the proprietor can sell it, and he does not care about the finish, if it will sell without it, and the workman has not the pride in his work to care whether it is black or white, so he gets it out of the lathe, and gets another job started.

Of the metals to finish, cast steel is, perhaps, the most difficult to turn smooth. It takes more filing, and, as a consequence, takes more time to polish, but can be brought down very fine, if the proper pains are taken. For any work where steel is required, good machinery steel is profitable to use. It makes good work, and finishes nicely and easily. In iron, good American hammered iron is the best for finishing. Swedish or Norway is too porous, or soft and tenacious. The American is closer grained, and will take a finer finish, and, if free from grit, is easily turned smooth, so that the polishing can be quickly done. All of the above remarks are made with reference to a straight piece of turning, which I consider the most difficult to finish to suit a critical eye, whether iron or steel, because it is difficult to arrange the scratches uniformly. In a job of cast iron, the iron should be fine and close grained, not hard. The same principles should be carried out in turning that are described with reference to turning wrought iron, viz.: for a last cut before finishing, a wide, flat-nosed tool, with a keen cutting edge, should be used, also very light cut, just a scrape, a coarse feed, with the speed of the lathe at the limit that the tool will stand. No filing, but use a scraper, an old file makes the best; grind the cuts out of both sides. The end should be ground the least shade rounding, and smoothed with an oil stone, so that the corners are perfectly smooth. Have a solid rest, and place the scraper against the work in a horizontal position, with the right hand, or the one holding the handle down, low enough to bring the scraper to a position in which it cannot cut. Then hold it solid on the rest with the left hand, raising the right, until it cuts. This gives so little that it cannot chatter, and it will be found that very little work will finish the job. Do not undertake to slide the scraper along the rest to make it scrape continuously; this cannot be done. The edge being slightly round gives a chance to carry the right hand in the form of a circle, and scrape the width of the scraper without moving it on the rest. For this reason, it is better to use a wide scraper. It should not be pressed hard against the work. If it does not cut smoothly and easily, with the end against the work, and the right hand raised, (thus throwing the cutting corner hard against the work) then it is either not ground rightly, or the temper or steel is defective, and should be immediately attended to. As for polishing, the same hints will answer as in polishing wrought iron; all the difference is, it will require a little more patience, but the result will reward the careful workman. In irregular shapes of work, the workman must vary the shapes of tools, but always keep the principle of sharp tools and scarcely any clearance well in mind. Much more could be said upon this subject, but perhaps the hints I have suggested will be of some benefit to workmen.

New Planer and Matcher.

Herewith is represented what the manufacturers (Frank & Co., Buffalo, N. Y.) call the "Common Sense" planer and matcher.



New Planer and Matcher.

Its weight is about 3,000 pounds, sufficient to insure great steadiness and stability, even while doing heavy work. It is arranged to plane lumber up to 26 inches wide and 6 inches thick. The first pair of feed-rollers are connected by expansion gears, to allow a wide range of adjustment, while the other two pair, behind the cutter head, allow, with their star gearing, an adjustment of two inches. These can be removed when greater thicknesses are worked. The rollers all admit of side adjustment, either to, or from the cutters.

The cutter head and shaft are made from one piece of forged steel, and the shaft runs in boxes, cast solid to the frame. The head is slotted on the two sides, making it convenient for using header cutters, or cutters for moulding, and for weather-boards. It will carry two or four cutters, as may be desired.

The shaft is driven by two four-inch belts. All bearings are oiled by Purdy's self-oiling device. The matcher spindles do not come above the planer bed, so that in changing from matching to surfacing they do not have to be lowered.

The heavy planer bed is raised and lowered by means of two screws operated with one crank, and connected by bevel gears. Frank & Co's weighted chip-breaker is furnished with this machine, which, they claim, gives a uniform pressure, whether the matcher-head is reducing the width of board one-eighth, or one inch.

Krupp has recently taken out a German patent, says the *Universal Engineer*, for a new process for welding tubes and tires.

He draws the tube on a pair of ordinary rolls and heats the whole length of the portions which are to be welded in a portable fire-box, into which air is blown so that the heat is directed against the weld. After the necessary heat is obtained the rolls are set in motion, and the place which is to be welded is repeatedly drawn through them.

Charles O. Brown, general manager of the new rolling mill in course of construction at Samanca, Brazil, says the *Journal of Industry*, Pittsburgh, Pa., has been in that city for some days past purchasing an engine and other necessary machinery for the concern.

Thermo-dynamics—Force, Motion, Work and Heat.

BY JOHN W. NYSTROM, C. E.

1. *Force* is a tendency to stop motion. This definition of force is respectfully offered in competition with the one generally used, namely: *force*, is a tendency to produce motion. Either one of these two definitions is as good as the other, but neither of them is strictly correct. It is equally correct to say that motion produces force, as that force produces motion.

2. *Motion* is continued change of position, in regard to assumed stationary objects, and, therefore, motion and rest are only relative. Force and motion are two distinct principles which exist independent of one another, and, therefore, their definitions should be independent of one another.

3. Force is positive and negative actions of imponderable substances whose physical constitution we do not know, except as action and reaction which can be expressed by weight, without regard to motion. Force can be realized only by an equal amount of resistance which is also force, and either one can be called action and the other reaction.

4. A force, acting on a body free to move, will set that body in motion with accelerated velocity as long as the force acts, but when it ceases to act, the body will continue with a uniform motion. In cases like this, philosophers say that the force was converted into motion, which is an error, for the force only ceased to act. The body will continue the uniform motion until some external force acts to change the same, and if that force is applied opposite to the direction of motion, the velocity will be retarded as long as the force acts and finally brings the body to rest.

5. The inertia of the body acts as resistance to the applied force, and when a moving body is brought to rest, this inertia is the acting force which overcomes the resistance of the applied force, in which case it may be said that the resisting force was converted into rest, as the original acting force was converted into motion, but force and motion or rest cannot be converted into one another.

6. *Heat* is force. This definition of heat is respectfully offered in competition with that of Tyndal, namely: heat is a mode of motion. Either one of these definitions is as good as the other, but neither of them is strictly correct. Force, motion and heat are three different principles, neither of which can be represented by or converted into one another, and, therefore, their definitions must be different.

7. According to the present teaching of thermo-dynamics, heat and work are convertable into one another, and consequently work must be a mode of motion, but, fortunately, we know the constituent elements of work, and that it cannot be converted into motion, and, therefore, heat is not simply a mode of motion.

8. *Work*, is the product of the three simple physical elements, *force*, *velocity* and *time*. The product of velocity and time is linear space, and, therefore, work is also the product of *force* and *space*, which is the acknowledged and well established definition of work, and, if it can be converted into heat, the latter must evidently constitute the same elements, and, therefore, a mode of motion is only one element of heat.

9. Even if Tyndal's definition of heat was correct, it is still of no use so long as the *mode* is not defined. Clausius defines radiant heat to be *undulatory motion*, in distinction from other forms of heat which he calls *mode of motion*, in which case the *mode* is defined in radiant heat; but when motion occurs, there must evidently be *something* that moves, and that is what we want to know in Tyndal's definition of heat.

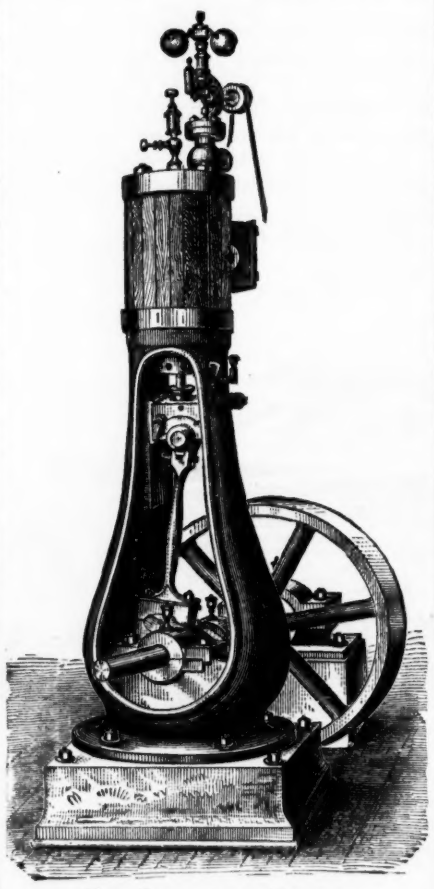
10. Clausius says: "In all cases where work is produced by heat, a quantity of heat is consumed proportional to the work done; and inversely by the expenditure of the same amount of work, the same quantity of heat may be produced.

"Work may transform itself into heat, and heat conversely into work; the quantity of one bearing always a fixed proportion to that of the other."

11. This is the law of thermo-dynamics now generally accepted; it was first developed practically by Zoul, and theoretically by Mayer.

It is not clear to the writer that heat can be transformed into work, and work into heat; but it is perfectly clear that work is produced by heat, and heat by work; that either one can transform the other, but neither one can be transformed into the other.

12. Suppose a steam cylinder of one square foot area of piston to be worked with steam of 100 pounds pressure to the square inch, which will make a force of 14,400 pounds on that square foot. Let the piston move one foot with full steam, and the work accomplished will be 14,400 foot pounds. The total units of heat in that steam, counted from water at 32°, heated and evaporated under 100 lbs. pressure, will be 275.5, and



THE GREENFIELD ENGINE.

the work realized per unit of heat expended, will be 14,400 : 275.5=52.268 foot pounds.

13. Now let that steam be discharged into and condensed in one cubic foot of water of 32°, which will be heated to nearly 37°, and we have all the original heat in the steam restored into sensible, although it performed 52 foot-pounds of work. Consequently, the heat was not lost but transformed by the work it accomplished. The latent heat in that steam was 207.39 units, which make the equivalent 14,400 : 207.39 = 69.434 foot-pounds of work per unit of latent heat.

14. Take a fresh supply of one cubic foot of steam in the cylinder, and let it expand by moving the piston one foot farther, that is, one cubic foot of full steam, and one cubic foot of expansion, making the stroke two feet in which the mean pressure will be 84.657 pounds to the square inch, and the work accomplished from the beginning of the stroke will be 144×84.657×2=24,381 foot-pounds, of which 24,381—14,400=9,981 foot-pounds gained by the expansion.

15. The total units of heat in the expanded steam should be the same as that in the original cubic foot of full steam, but the steam tables calculated from Begnault's experiments on heat in steam, and from Fairbairn and Tate's experiments on volume of steam, give 286.6 total units of heat in the expanded two cubic feet, from which it appears that the steam has gained 286.6—275.5 =11.1 units by the expansion, which can certainly not be the case, but those experiments and deductions therefrom are evidently wrong.

16. The dynamic equivalent per unit of heat will be 24,381:286.6=85.07 foot-pounds, of which 85.07—52.26=32.81 foot-pounds were gained by the expansion. The dynamic equivalent per unit of latent heat will be 24,381:225=108.36 foot-pounds. The units of heat transformed from sensible to latent during the expansion will be 225—207=18, which will make the dynamic equivalent 9,981:18=554.5 foot-pounds per unit of latent heat. This should be the correct value, but it is too small on account of the steam tables being wrong.

17. Now let the expanded two cubic feet of steam be discharged into and condensed in one cubic foot of water at 32°, and we have the total units of heat fully restored into sensible, after it has performed 24,381 foot-pounds of work. The heat was consequently not lost by the work it performed, but was only transformed into a lower temperature. It is not necessary that the steam should be condensed in exactly one cubic foot of water at 32°, which is done only for convenience in using tables.

18. Take again a fresh supply of one cubic foot of steam in the cylinder, and let it expand four times, that is: one cubic foot of full steam expanded three feet, making the stroke four feet. The mean pressure throughout the stroke will then be 59.657 pounds to the square inch, and the work acccomplished will be 144×59.657×4=34,362.4 foot-pounds of which 34,362.4—14,400=19,962.4 foot-pounds of work gained by the expansion. The total units of heat in the four cubic feet of the expanded steam will then be 293.64.

19. The dynamic equivalent realized per unit of total heat will now be 34,362.4:293.64 =117 foot pounds, and per latent heat 34,362:239.768=144.32 foot-pounds.

The heat converted from sensible to latent during the three feet expansion will be 239.768—205.67=34.1 units, and the work performed by these units was 19,962.4 foot-pounds, from which we have the dynamic equivalent 19,962.4:34.1=585.4 foot-pounds, which is 585.4—554.5=31 foot-pounds apparently gained by expanding the steam four times instead of twice. This apparent gain or difference is not real, but due to the errors in the tables before alluded to.

The four cubic feet of the expanded steam discharged and condensed, as before explained, will restore all the original heat to sensible, after it has performed 34,362.4 foot-pounds of work.

20. It is the transformation of heat from sensible to latent, or from latent to sensible, which represents work, and which equivalent is probably over 800 foot-pounds per unit of latent heat, but our generally accepted steam tables are not sufficiently correct to give that result.

The steam tables in the writer's new treatise on steam engineering are the most correct yet in print. These tables are calculated up to 1,000 pounds steam pressure to the square inch, and they agree with thermo-dynamics.

The Greenfield Vertical Engine.

We illustrate herewith a vertical engine, for which the builders do not claim any novel features. The qualities which recommend it are its symmetrical proportions, strength compared with lightness of parts, quality of materials used in construction, superior workmanship and finish.

The steam joints are scraped and ground to an accurate bearing, thus obviating the difficulties attending the use of rubber or paper joints. The crosshead is provided with composition gibs, which are adjustable to take up lost motion. The shaft, piston rod and crosshead pin are made of forged steel. The piston packing is composed of spring rings. All the moving parts are evenly balanced, thus insuring a steady and uniform motion. These engines are made interchangeable in all their parts. The governor used is the Waters or Gardiner, as may be desired.

There being a desire on the part of some to have an engine equally as good as the engine alluded to, without the fine finish, to meet this demand, there are also two classes of these engines manufactured, which are designated as the "extra finished" and the "plain finished." The same quality of material is used in making both classes, and the same amount of labor expended on the wearing parts. On the extra finished engine, the steam chest and cover, crosshead governor pulley, and all the brasses and nuts are highly finished. This engine is also adapted to yachts. The sizes now made are from 3¼"×5" up to 9"×9". The Greenfield Engine is supplied to users of power by Wm. Cooke, 6 Cortlandt St., N.Y.

Apprentice Papers.

BY CHORDAL.

IV.

GENERAL PROPERTIES OF MATTER CONTINUED.

We know very little of the real cause of natural forces. We know that some great force tends to draw the atoms of some matter closely together, and we call that force *cohesion*. We know that some great force tends to force the atoms of some matter apart, and we call that force *repulsion*. While we know little of the cause of these forces, we may, by close observation, become familiar with their general laws of action, and it is a knowledge of these general laws of nature which forms the basis of science and of all practical operations with matter.

In many substances, as has been stated, some natural force causes one atom to draw closely and powerfully toward other atoms.

There is also another natural force which tends to draw all atoms and all substances; in fact, everything, toward the center of the earth. This force we call *gravity*. Cohesion draws the atoms composing a piece of iron closely together with great force, and gravitation draws the piece of iron powerfully toward the center of the earth. It seems as if all pieces of iron, and all other pieces of matter, were simple atoms constituting a great universe which the force of gravitation was seeking to bring to the center of the earth. If we lift a weight it falls, and if it could fall far enough its line of travel would pass through the earth's center. A plumb line suspended gives us the direction to the earth's center. Two plumb lines five miles apart, would each point to the earth's center, and as the earth is round, these two lines would not be parallel. They would be further apart at the top than at the bottom, and would cross at the center of the earth. A very long building, whose walls are perfectly plumb, is wider at the top than at the bottom. A little study will show that this tapering building with the large end upward is the most secure form. The stones composing it tend to fall to the earth's center, and as the walls are built in that direction, it follows that each stone is supported by other stones placed directly under and in the real path of the force of gravity.

Gravity acts with a different degree of force on different substances. Those substances which are attracted powerfully we call *heavy* substances, and those which are attracted but slightly we call *light* substances. In comparing heavy and light bodies we speak of their *weight*.

In referring to the size of bodies, science uses the term *mass*, which means the same as bulk. A large thing is spoken of as a thing of great mass.

In studying the action of gravity we must consider it as acting of substances of equal mass. Thus it would not be proper in investigating the laws of gravity to experiment on one cubic foot of lead and two cubic feet of iron. The mass of the iron would then be twice the mass of the lead, and we could determine but little as to the laws of gravity.

We should deal with equal masses and study closely the different effects of gravity on similar masses of different substances. As before stated, when the atoms of a substance are packed closely together we say that substance is *dense*. If a substance is

very dense we can readily see that there is more matter than ether in it; while if it is very porous there may be very little matter in a large mass. Gravity acts on substances in proportion to their densities.

Lead is a very dense material; gravity acts on it powerfully and we say it is heavy. Cork is very porous; gravity acts on it slightly and we say it is light.

A cubic foot of cork weighs fifteen pounds, and a cubic foot of lead weighs 700 pounds. We say that lead is more than forty-six times as heavy as cork, There is so much difference in the density of these two substances that we can easily see it. We see great pores in the cork, and thus know that the particles composing it are not packed closely together as they are in lead. Still the mass of the lead and the cork is the same, for we are speaking of a cubic foot of each. There is the same difference in nature between all substances as we see in these two substances, but the degree of difference is not the same. Thus cast iron is very much denser and heavier than cork, but is lighter and more porous than lead.

If we should compress a cubic foot of cork with sufficient force we might make it very dense, and reduce its mass so that forty-six cubic feet would occupy only one cubic foot of space. If we should do this the cork would become as dense as lead, and its weight would be the same.

Gravity acts on all matter. There is no substance which does not have weight. If we take an evenly balanced pair of scales and place a cubic foot of lead in one pan and a cubic foot of cork in the other pan, the lead will be drawn downward by gravity; the cork will also be drawn downward by gravity, but the superior attraction for the dense lead so far overbalances the attraction for the porous cork that the cork rises and lead falls. Iron dropped into water sinks and crowds water upward, while iron dropped in quicksilver is held upward and floats on the heavier quicksilver.

Most all substances will drop through the light air, but common gas is lighter than air, and floats upon it. The air is the heaviest, and is attracted the most by gravity. All these substances, however light and airy, have some weight. We look upon the air as a something having no weight, because we are always comparing it with substances very much heavier. Air has weight, and a bottle full of it will weigh more than a bottle from which all air has been exhausted. Air weighs seven one-hundreds of a pound to the cubic foot. It would take 10,000 cubic feet of air to weigh as much as one cubic foot of lead.

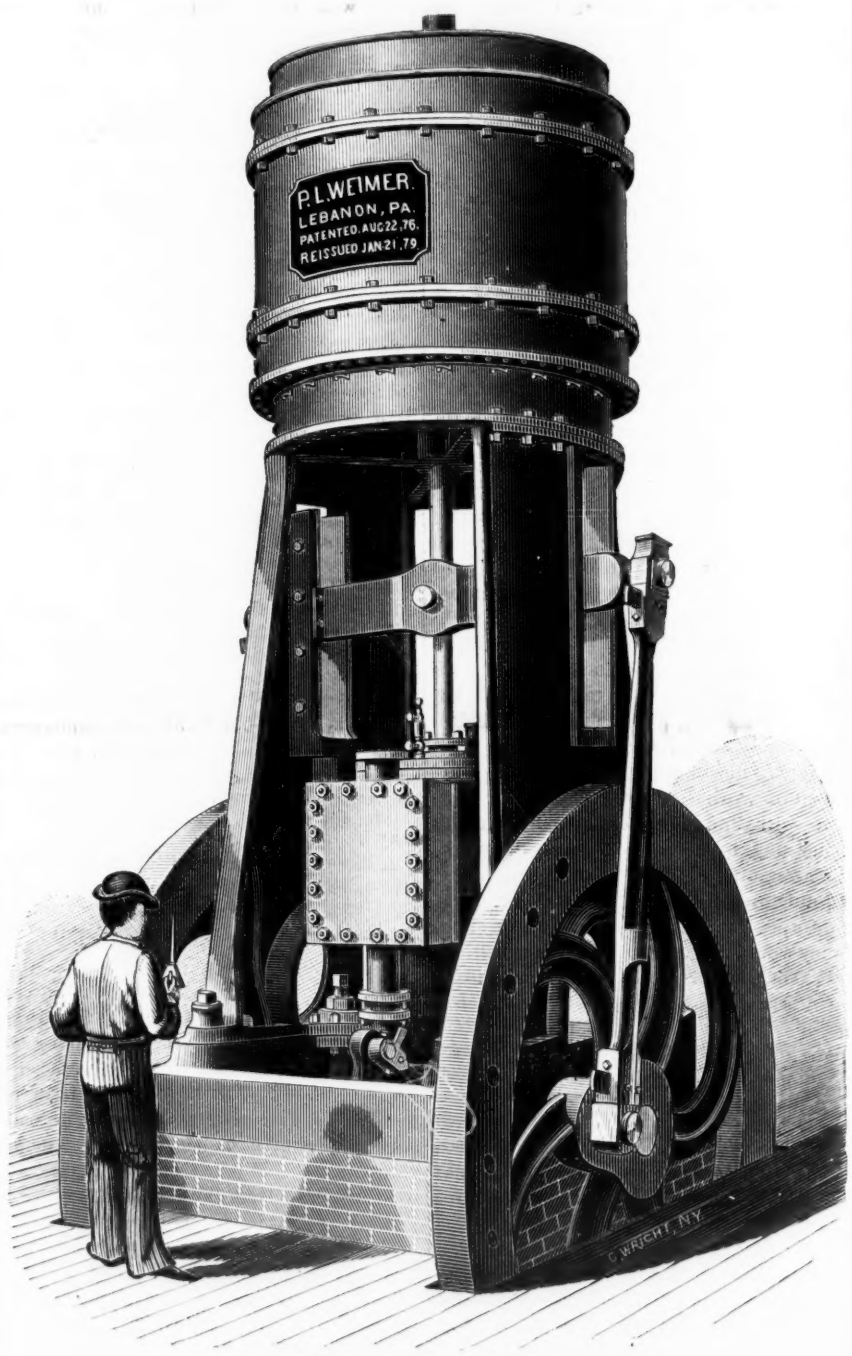
We have before noticed that the closer together the atoms of matter are packed the greater the cohesion. This is also true of gravity acting on matter. The closer matter is brought to the center of the earth, the more it is attracted by gravity. Gravity acts with much greater force at the bottom of a deep mine than at the top of a high mountain.

The Weimer Blowing Engine.

The earliest use of artificial blast, of which we have record, was for metallurgical purposes, and we can trace the development of blowing apparatus from the reed applied to the mouth of the smith, through hand bellows of various forms, piston blowers of rudest or improved types, the "pacers," and water-power blowers, fans and rotary blowers, all employed in metallurgy, to the present perfected apparatus.

The injection of air under pressure into cupolas, converters, or furnaces, has inspired the inventing of much machinery of ingenious construction to accomplish the desired results; but as a class, blowing apparatus has not reached the perfection which has been developed in other branches of machinery.

It has been possible to secure high duties from well built steam engines, driving factories or shops by operating them at such speeds as to insure the most efficient work with a comparatively small engine. So in rolling mills and marine engines, the use of direct connections has brought the economic work up to a standard much in advance of what was supposed to be the maximum. But with blowing apparatus, the mechanical engineer has had to choose between employing, 1st. a massive machine, being a steam cylinder, directly connected to a blowing cylinder or cylinders, to do a really small amount of work. 2d. A steam engine operating blowing cylinders by means of gearing, so as to get a greater speed in the steam cylinder (and, consequently, better results in it) than was possible in the blowing cylinders, or, 3d, rotary fans or blowers which, like rotary engines and pumps, are far from being economical as to power employed, and are limited as to pressure obtainable. With the first two classes, the difficulty was in the slow speeds at which it was necessary to operate them, and this difficulty was mainly owing to the valve arrangements of the blowing cylinders. To make the hinged valves seat rapidly enough, extraneous forces, like springs, had to be applied, and the valves rapidly destroyed themselves; and if disk valves were employed, they were weighted so as to secure the desired action; but in all arrangements of the valves in the heads of the blowing cylinders, it was impossible to get the area of inlet or outlet of sufficient size to secure economic operation.



The Weimer Blowing Engine.

Mr. P. L. Weimer, of Lebanon, Pa., claims in his patent blowing engine, one style of which we illustrate, to have overcome the disadvantages which have been a feature of other blast engines, and secured a machine of moderate size, having valves complete in themselves, taking seat quickly, without the application of springs or weights, and which permit of running the engine at a speed most conducive to efficiency in the operation of steam. He also claims to secure, by the arrangement of valves in the blowing cylinder, an aggregate area of opening for the induction and eduction valves much in excess of any other disposition heretofore made of them.

Recognizing the peculiar adaptation of a vertical arrangement for this class of engine, in that the air between the piston and cylinder head acts as a cushion to relieve the crank-pin from much of the strain at the change of stroke, these engines are constructed of the upright pattern, and the blast cylinders are supported on iron housings or columns, as is deemed most expedient, or required by the customer. Similarly, they are made with either poppet or seat valve motion; the engine illustrated is of the latter class.

The most marked peculiarity of these engines is in the blowing cylinder. This is made different from the ordinary type in many particulars. The cylinder is cast with double shell, the annular space between the two thickness of metal serving as an accumulator to receive the air passing through the discharge valves. The piston resembles a broad faced pulley, having arms radiating from a hub, and with a horizontal web dividing it into two parts.

The heads of the blowing cylinder are divided into sectors; into each of which is keyed, so as to be readily removed, a sector-shaped box, having the three sides and bottom perforated with slots, against the sides and bottom rest the valves, which are of sheet gum perforated with slots which alternate with those in the box and correspond with others in a guard, so placed as to allow them to leave their seats but $\frac{5}{16}$ of an inch. The entire area of the cylinder proper is occupied by these receiving valve boxes, and in the portion corresponding to the annular space between the two walls a series of curved boxes contain discharging valves of similar construction. The entire area of the cylinder being occupied by the receiving valve boxes, with valves in sides and bottom, secure a large area of inlet, and the slots for the discharge valves extend entirely around the periphery, and are of sufficient size to give free exit for the air. The arms and rim of the piston pass into the spaces between the boxes, thereby avoiding the disadvantage of slush room, of which there is less than in any other style of engine.

As the valves move in horizontal or vertical planes there is no destructive action in their operation, while the small lift given to them permits of rapid seating, and insures their continued integrity. Such being the case, it is evident that the speed of the engine is not restricted by the air valve motion, and consequently the most advantageous operation of the steam cylinder is attainable.

It is also obvious that a small blowing cylinder, in which a piston can operate rapidly, can do the work of a much larger cylinder, the speed of whose piston is held in check by any cause. Consequently, one of the prominent claims of superiority of these engines, is that a comparatively small engine of this construction does the work of a much larger machine of the ordinary build, thus securing a saving in first cost of engine, foundations and engine house, and by its economy of operation, a continual reduction in running expenses.

For foundry purposes the smaller sizes of these engines have given great satisfaction, and to give the advantages of this style of apparatus to those who do not desire a separate steam engine, blowers, consisting of one or more blast cylinders, are constructed on Mr. Weimer's patents, and arranged to be operated by a belt wheel from the power which drives the shops, or as in one case by gearing from a turbine water wheel. A number of sizes of these engines are constructed so as to meet the varying requirements of trade, at three different machine works under license from the patentee, P. L. Weimer, Lebanon, Pa., and 152 South Fourth St., Philadelphia.

According to one of our Melbourne exchanges, *The Australian Trade Review*, the manufacturing industries of Australia are not very bright. The last number of that publication that has reached us (date of Aug. 5th), contains the following dolorous review:

The iron, copper, and brass trades have been very dull during the past month. There has been very little new work doing, and whatever work is going on is mostly in the way of repairs. There are, of course, a few exceptions, and a notable one is the case of the firm of Messrs. Robison Brothers, who keep 250 hands in full work. This firm has quite recently completed a locomotive for the Government, which is now running on the Victorian railways, and is doing good work. The heads of the department have signified their entire approval of it, declaring that it is the best finished locomotive ever turned out in the colony, and that it cannot be excelled by any engine that may be imported. Another locomotive by the same firm is rapidly approaching completion, and will soon be placed on the Victorian lines.

With regard to general machinery, it would be difficult to recall a time when orders were so scarce as at present; and added to that, the difficulty of getting money is rendering all matters of business as unsatisfactory as they can well be.

What activity is shown in many of the workshops this month is owing to the preparation of exhibits for the International Exhibition; and this, we need hardly say, is rather a matter of speculative interest in the future, than of immediate profit. It is, therefore, a disheartening time to sink capital and prepare exhibits in quantity and quality worthy of our Victorian manufacturers.

Boiler Explosions.—At the annual meeting in Wolverhampton, England, of the Midland Steam Boiler Inspection and Assurance Company, it transpired that out of 3,200 boilers in the company's care there had been *no explosion for two years*, notwithstanding that the company's work was mainly amongst iron works and colliery boilers, which for years past have furnished most of the fatal explosions.

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NEW YORK, OCTOBER 2, 1880.

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Need of More Skilled Mechanics.

The question most important to the mechanical progress of our country is that of providing for the proper training of young men to become skillful artisans. Wherever constructive industries are briskly driven to supply the demand, as they are just now, the scarcity of expert and reliable workmen is a cause of widespread regret and disappointment. We have presented this subject in these columns again and again, and recur to it once more, with the hope that it may stimulate some to greater efforts for improvement, and thus qualifying themselves to take the more advanced positions, with a corresponding increase of wages. In the machine shops, both East and West, there is a most earnest inquiry for good, capable workmen—not so much for the men who know how to do but one thing in the business, as for those who are able to take the lead and perform almost any operation required without special instructions from the foreman at every turn.

As a rule, shop-owners are not over anxious to instruct young men in all the details of the machinist's trade. Their solicitude is naturally directed to securing the best class of workmen, and for their services they are everywhere willing to pay good wages. Young men who set out to learn a trade must strive to acquire an actual knowledge of the business, step by step, as they spend their time for the purpose, and not settle down to one branch of work for many months steadily. Apprentices must acquire the habit of independent thought, and if shop-owners insist upon their sticking to a particular part of the work at which they have become adepts, *leave* and go to another place where they can have the opportunities needed. The ability to earn a few cents a day more in feeding a machine without learning anything by the work ought not to determine an ambitious youth to stick to the job, rather than to take less and advance himself in mechanical knowledge. He is likely to be, for the present, more valuable to his employer to not change his branch of work. A few years later, however, will find him commanding much higher pay by making changes in work, while pursuing his apprenticeship.

Young machinists must probe every source of information, both in and out of the shop, if they would advance to the higher positions and extra grade of wages. The demand is for machinists *already made*, not for material out of which to make them. Ways are open, however, for energetic and aspiring young men to qualify themselves to meet the demand.

Chordal has been attending a National Convention (not political), and, on account of taking a prominent part, has not found time for "Extracts" in the last two weeks. Our readers may expect to hear from him next week, as usual. Meanwhile, we would call attention to his Apprentice Papers, No. 4, which will be found on page 6.

An Engine that Needs Testing.

It is not often that a $5,000,000 stock company is formed upon either real or imaginary steam engine improvements or discoveries, but when such an event does happen, to use a hackneyed phrase, "it deserves something more than a passing notice." We accorded the Cloud Engine Co. (capital, $5,000,000), a passing notice in the AMERICAN MACHINIST of July 24th, which did not seem to please the officials of that extensive corporation. About a month afterwards they took occasion to call at our office, and indulge in some obstreperous declarations about being misrepresented. We offered to give publicity in these columns to their reply to our strictures on their so called invention of increasing the power of a steam engine by blowing cold air into the cylinder, and mixing it with hot steam; also their indisposition to allow a full and complete investigation of its operations. Following is their letter :

TEMPORARY OFFICE
OF THE
CLOUD ENGINE COMPANY,
42 & 44 New Street,
NEW YORK.
J. A. H. HASBROUCK, Pres't.
MORTIMER S. BROWN, Treas'r.

New York, August 19, 1880.

HORACE B. MILLER, Esq., Pres't
AMERICAN MACHINIST Pub. Co.,
96 Fulton St., N. Y.

Dear Sir: Our attention was called only yesterday to an article in the issue of your paper under date of July 24, 1880, headed "Incorporated Frauds," and in reference to which we called twice yesterday afternoon at your office.

The article referred to states that the expert "asked the privilege of testing the boiler, engine, and appurtenances, commencing by weighing the coal before feeding it into the furnace. This request was flatly and decidedly refused, the proprietors of the wonderful fuel economizer not desiring to have any test of that kind undertaken. They were not prepared to entertain such a proposition."

In answer to the above we state explicitly not only was there no such refusal, but that the expert referred to did not make any such request.

Instead of *refusing* to allow such tests, we have *invited* them, and offered the control of our engine and all appurtenances, to any and every competent engineer who might desire to make them. Respectfully yours,

J. A. H. HASBROUCK, Pres't.
M. S. BROWN, Sec'y.

Cloud Engine Co., 42 & 44 New St., N. Y.

The next day after the date of the above epistle, we sent the Cloud Engine Co. the following proposition:

In your communication of Aug. 19th, you say in reference to the tests: We have "offered the control of our engine and all appurtenances to any and every competent engineer who might desire to make them." We desire to make a test with competent engineers. If you mean what you say, please sign the enclosed plan for a simple test, naming date and return.

PLAN FOR TEST OF THE CLOUD ENGINE.

1. Examine the engine-boiler and all appurtenances, and take measurements whenever necessary.
2. Weigh all the coal or other fuel used during the test, also all the water.
3. Take indicator cards from the engine, and apply the dynamometer.
4. In short, make a fair and impartial test of the Cloud Engine.

The above plan is accepted, and the test may be made Aug.——

A day or two after mailing the above, we had a call from the President of the company, who entered into a wordy explanation of the reasons why the engine could not be tested until certain changes were made. We informed him that we desired a written reply to our request, with something definite in regard to date upon which a test could be made, if we were to be allowed to make it at all. Not hearing anything further from the concern, we wrote them again Aug. 30th: "Please let us know whether you accept the offer to test your engine, and if so, when the test can be made."

Below, we present the verbatim reply to this repeated request.

TEMPORARY OFFICE
OF THE
CLOUD ENGINE COMPANY,
42 & 44 New Street,
NEW YORK.
J. A. H. HASBROUCK, Pres't.
MORTIMER S. BROWN, Treas'r.

Sept. 7, 1880.

Editor American Machinist:

DEAR SIR: I am in receipt of your note of the 30th ult.

On the receipt of the note to which you therein refer, you cannot have forgotten that I called to see you, and not only accepted, but invited the examination and tests which you proposed to make of the "Cloud Engine."

I then stated, and now repeat, that for the purpose of making the test more satisfactory, I thought it best to have a "cut-off" added to the engine, inasmuch as several engineers, upon examining the engine, deemed it expedient, as "Cloud" is essentially an *expansive* power.

At the time I saw you, there was a doubt as to whether the engine would be kept where it is now, or removed to some other location. It has been concluded to keep it, for the present, here, and the work of putting on the "cut-off," which, for that reason, had been delayed, will now proceed as rapidly as practicable. I am assured it will be done within "about ten days," and as soon as it is completed, I will be most happy to give you, and any first-class engineers you may select, every facility for making the proposed test. All that I desire, for myself and associates is, that the test be made in the most thorough and exhaustive manner, and that you give the result as great a publicity as you did the article in your issue of July 24, to which I took exception.

Very respectfully yours, etc.,
J. A. H. HASBROUCK,
Pres't. Cloud Engine Co.

The "about-ten-days" period is nearly completed, but our plan for a test has not been returned as accepted, nor any day named for the test. When we have an opportunity to test the Cloud engine, our readers shall have the full particulars. Meanwhile, we suggest to capitalists, who contemplate investing in the stock of this company, to await the results of our test.

"Stuffing castings" for machinery is a custom that has long been observed by some of our best machine tool builders. A heavy priming of paint is first applied, which is thoroughly rubbed in by the use of pomace stone. This operation is performed by boys or cheap workmen. The job is finished by carefully painting it a steel color.

The Cincinnati Exhibition was opened Wednesday, Sept. 10th, with a fine display of objects of art and industry. At the opening exercises a letter was read from C. W. West, a retired merchant, offering to give $150,000 to establish a permanent Art Museum, provided the citizens of Cincinnati would subscribe the same amount. The Inter-State Exposition opened at Chicago on the 8th of September, with a good representation of the industries of the northwest. The Pittsburgh Exposition opened the first of September, and attracts a great many visitors. Many improvements have been made since last year. The American Institute Fair in this city opened Sept. 15th, and, as usual, is drawing crowds of visitors every day. The St. Louis Annual Fair will open October 4th.

A Peculiar Locomotive.

There is much discussion at the present time among the men engaged in the different locomotive works at Paterson, N. J., over a locomotive of peculiar design, which is now in an advanced state of construction at the Grant Locomotive Works. Some papers have described it, when finished, as having the appearance of an ordinary locomotive turned upside down, and having two pairs of driving-wheels, one placed above the other, with the surfaces of their rims in contact with each other.

The locomotive to which we refer has a boiler of the ordinary type, known as the soft coal style. The frames are to be attached to the sides of the boiler, and are to rest upon two pairs of driving wheels, a trailing pair of wheels and a truck.

The main driving wheels have a projection or rim cast upon the inside having a smaller diameter than the wheels themselves. The other pair of driving wheels is to rest upon these rims. By applying the springs to the upper, instead of the lower pair as usual, the weight is utilized to press the wheels firmly together. The cylinders are located at about the middle of the smoke arch, and are inclined upward. The cab is to be placed at the front end instead of the back. The links and valve motion must necessarily be placed on top of the boiler.

Introducing the inclined cylinders is a retrograde movement in locomotive building, and by adopting this plan all the difficulties (such as a vibratory or pumping motion while the engine is running) heretofore experienced with engines having inclined cylinders, will be experienced. These difficulties increase with the angle of inclination, which, in this case, is extreme. The driving wheels connected with the engines are of such a diameter that for each revolution, the wheels in contact with the rail will make about three. The upper pair of wheels revolve in the opposite direction from the lower pair. We are convinced that the inventor will find that his ideas of transmission of power, by the friction of two round-

ing metallic surfaces will come far short of his expectations.

We understand that a hydraulic apparatus is to be provided for forcing the surfaces of the wheels into closer contact. This plan will greatly increase the friction upon the journals, and require much more power to turn them. The object of the inventor is to attain greater speed than with the ordinary style of locomotives; but we prefer to wait and see if the engine will run at all before we discuss the question of its speed. The engineer is to be placed in such an exposed position, that should an accident occur to the engine, or a collision become imminent, he would have an exceedingly poor chance of escape with his life.

Complaint is made of the usual style of locomotive, that the weight is too much above the wheels, or, in other words, the engines are top-heavy. In the new plan referred to, the cylinders are raised above the usual position, and in fact, all the machinery usually placed below the boiler is located on top of it. In raising the weight higher above the rails, the engine is more inclined to rock, and the difficulties arising from this cause in the ordinary locomotives are very much increased. The inventor seems to have great confidence in the success of his system, for the materials used in the construction, together with the workmanship of the new engine, are fully equal to the other engines built by the Grant Locomotive Works.

Our readers will be gratified to learn that Mr. A. L. Holley, one of our most esteemed and progressive American engineers, who was recently dangerously ill in London, is rapidly convalescing, and is expected soon to be well again. On his departure for Europe last May, Mr. Holley promised one or more letters for publication in the American Machinist, but his unfortunate illness has deprived our readers of the pleasure of seeing them.

Literary Notes.

THE LOCOMOTIVE TORCH. By Frank C. Smith, M.E., B.L.E. (V. Hook) Price, $1. Published by Geo. H. Frost, New York

This book is not intended as a treatise on the locomotive, but is composed of a series of practical articles upon the every-day experience of the locomotive engineer. A number of these articles have been published in the columns of the American Machinist. The book contains sixty pages, is bound pocket size, and printed in clear type.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common sense methods.

(1) J. F. T., South Framingham, Mass., writes: We are setting a 50 H. P. boiler, and the blow-off pipe comes 6 feet below the surface of the ground. There is no sewer or drain to blow into, neither can we dig a well, as it would fill with water. Please let me know if we can blow the boiler out dry if the blow-off pipe is run to the surface of the ground, and what pressure it would take to accomplish the work. *A.*—You will have no difficulty in blowing all the water out of the boiler in question by doing as you propose, provided you have a reasonable pressure in the boiler previous to blowing off. We do not advocate the emptying of boilers set in brickwork under pressure, particularly where the bricks come in contact with the boiler, but where a locomotive boiler or other internally fired boilers are used it may be safely done. We do not know what style of boiler you have and therefore leave that part to your judgement. Allowing for friction, etc., a pressure of 4 pounds per square inch will raise the water, causing a stream to flow at the surface of the ground (6 ft.), the practical allowance for the pressure of a column of water being 1 pound for every 2 ft. of height.

(2) J. O. H., Baltimore, Md., asks: Will you kindly inform me how I can temper brass, such as they use for valves in pumps? I can draw the temper, but cannot temper the metal again. *A.*—There is no process for tempering brass. It may, however, be hardened. You have doubtless thought that hardening and tempering mean the same thing, which is not true. When brass has been annealed it may be hardened by being hammered with a smooth faced hammer. Springs are made of sheet brass by this process. Rolling will also accomplish the same result by compressing the particles of metal, making it more dense.

(3) J. A. M., Cleveland, O., asks: Will you please tell me the way to set an independent cut-off, working upon the back of the slide valve of a steam engine? In what position should the eccentric that works the cut-off be placed in relation to the crank? *A.*—The position of the eccentric for operating an independent cut-off depends upon circumstances, viz., at what part of the stroke it is desired to cut-off, also the proportions and travel of the main valve, and travel of the cut-off valve. We refer you to the following articles, one on Valve Motio Diagram, by V. Hook, contained in our issue of Sept 27, 1879, also Motion Curves, by the same author, Oct. 18, 1879. If, in referring to these articles, you fail to obtain the desired information, send us the dimensions of the valve motion, and we will inform you.

(4) J. P., Overbrook, Pa., asks: Would you please give me a receipt for removing iron rust from iron where emery paper cannnot be used? I have a key which got salt on it, and emery paper cannot be used in the fine slots. *A.*—To remove iron rust from bright, irregularly formed articles, soak in kerosene oil or benzine over night, clean with a stiff brush and loose emery. The best way to prevent a re-ocurrence of the trouble is to get the key plated with nickel or silver.

Business Specials.

40 cts. a line for each insertion under this head.

Thomas D. Stetson, Patent Solicitor and Expert in Patent Cases, No. 23 Murray Street, New York.

Wilkinson & Crowell, No. 506 Walnut St., Philadelphia. "Paragon" Piston-rod Packing, entirely metallic, automatic, frictionless, and practically free of steam pressure. Will work on high-speed or condensing Engines.

John A. Caldwell, Mechanical Engineer, 94 Liberty Street, New York.

Blowers for all purposes. Exeter Machine Works, 50 Federal Street, Boston.

American Watch Tool Co., Waltham, Mass., Whitcomb Watch Makers' Lathes, and Watch Machinery.

See Standard Turbine advertisement in last issue.

A 4½ in. 2 Jaw Chuck, Independent or Universal for Brass Work. A. F. Cushman, Hartford, Conn.

Power Shears. Stiles & Parker Press Co., Middletown, Conn.

Steam Cylinders bored from 3 to 110 inches. L. B. Flanders Machine Works, Philadelphia, Pa.

Paper Making Machinery—Makers of above from fibrous material as wood, esparto grass, etc., send address to Joshua Rose, P. O. Box 3306, N. Y. City.

Engines, Hoisting and Pumping Machinery for Mines. The Band Friction Hoist, which is the safest, simplest, strongest and best in the market. Also, Friction Clutches. Address, Webster Camp & Lane Machine Co., Akron, O.

Rules for Engineers, and Removal of Scale in Boilers. Send for Circular. Ranken Scale Co., 50 Federal Street, Boston.

Dixon's Traction Belt Grease. Dixon's Founders' Perfect Wash. Dixon's Plumbago Foundry Facing. Dixon's Graphite Machine Grease. Dixon's Everlasting Graphite Axle Grease. Dixon's Dry American Graphite Perfect Lubricator. Send for explanatory circular to Dixon Crucible Co., Jersey City, N. J.

Manual of Power for Machines, Shafts, and Belts, with the History of Cotton Manufacture in the United States, by Samuel Webber, C. E., copyrighted 1879. Only work of the kind extant; 240 pages. Price $3. Address, D. Appleton & Co, New York, or the author, Manchester, N. H.

Sheet Metal Presses. Ferracute Co., Bridgeton, N.J.

Engines Indicated—Power Measured. W. H. Odell, Box 274, Yonkers, N. Y.

John Douglass, common and fine patterns made to order, also car wheels, working models, and experimental machinery. Shop at Washburn, Hunts and Co's Wheel Foundry, cor. Warren and Bay Sts., Jersey City, N. J.

Howard S. Abbot, Attorney at Law and Solicitor of Patents, 617 7th Street, N. W., Washington, D. C. Patent business of every description attented to.

Manufactures.

The American Oil Co., Boston, Mass., has been incorporated with Wm. F. Davis, President, and Edwin M. Fowle, Treasurer. Capital $32,000, in shares of $100 each, for the sinking of wells in Cape Breton, Nova Scotia, and raising oil therefrom, laying oil pipes to tide-water and selling the oil.

Extensive additions are in progress at the Malleable Iron Works, Hoosick Falls, N. Y.

The Cuyahoga Works, Cleveland, O., have a dozen or more of their blowing engines now on the stocks building for different sections of the country.

The Billings and Spencer Co., Hartford, Conn., write us: We are full of business; more orders for ratchet-drills, lathe-dogs, pocket-wrenches, and drop-forgings, than we can fill in the next six months.

Holyoke Glazed Paper Works, Holyoke, Mass., has been incorporated with Julius H. Appleton, President, and Alfred A. Andrews, Treasurer. Capital $40,000, in shares of $100 each, for the manufacture and sale of glazed and fancy papers and other goods of a kindred character.

The Edgemoor Iron Company has begun to deliver the steel for the superstructure of the East River bridge. The smaller trusses will be the first received, and larger pieces will soon follow. Some of the wire rope has been received.

The Portsmouth, Ohio, Foundry and Machine Works have made an addition to their shops, which enables them to shape steel for agricultural implements.

The committee appointed by the Youngstown stockholders to examine the stock and machinery of the Mower and Reaper Works, at Albany, N. Y., have returned, having appraised it at $43,000. It is intended to have the works in operation by December 1, and proposals for bids are now being advertised.

Several important additions are being made to the steam hammer and forge works of Smith & O'Leary, Chicago, to facilitate the working of the several departments. New cranes, fires, furnaces, etc., are being put in. They are turning out over 400 pounds of anvil work per day.

The Geo. F. Blake Manufacturing Company, of New York and Boston, are engaged in building a duplex pumping engine, of a daily capacity of 2,500,000 gallons, for the city of La Crosse, Wis. They have also under contract, and in process of construction, a pair of pumping engines with a combined capacity of 1,500,000 gallons daily for the new water works now being built at Stillwater, Minn.

The Atlas Engine Works Company, of Indianapolis, Ind., are having an 8,000 pound pulley, 12 feet diameter and 21 inches face, made at the Broadway Foundry, St. Louis, which is to be placed in a mill at Chicago.

The North Adams Manufacturing Company, North Adams, Mass., are making an addition to their power in the shape of a 140 horse-power Buckeye engine.

J. A. Stowell, of Leominster, Mass., is busy, working until ten o'clock nearly every evening with a full complement of hands, and is behind with his orders. He is making two 48-inch water wheels of the "Whitney pattern," to be used to drive one of Blake's Duplex Pumps to pump water for the Canon City Water Company, of Canon City, Colorado. One wheel is to be used at a time, the other to be kept in reserve in case of accident. It is estimated that they will lift a column of water containing 1,000 gallons 180 feet high per minute, the wheels to be run under an 8 foot head. He is also building a 24-inch and a 36-inch wheel to go to Leadville, Colorado, to be used by the Battle Mountain Smelting Company.

D. Saunders' Sons, Yonkers, N. Y., have just shipped a 6 inch pipe threading and cutting machine, to the Buffalo Grape Sugar Co., being the second machine of the kind sold to that Company.

Wood Brothers are preparing to build a large woolen mill on their property, near the dry-dock, at the head of Fifth street, Camden, N. J.

Crane Bros. of Westfield, Mass., are going to build an addition to their paper mill; eighty by forty feet in size.

It is rumored that the large hoe and fork factory at St. Johnsbury, Vermont, is to change hands. The present proprietors, Ely, Balch & Co., having dissolved, a corporation is to be formed, in which a number of well know Vermont capitalists will have an interest.

The Griswold Cotton Mills, at Coleraine, Mass., now run by steam power, the water in the river being too low.

The strikes in the axe factories of Hubbard, Bakewell & Co., at Pittsburgh, Pa., and at Beaver Falls, which lasted several weeks, are at an end.

The Pratt & Whitney works, at Hartford, Conn., are working five nights in the week.

All the mills, furnaces, foundries, machine shops, nut, bolt, rivet and boiler works in Youngstown, Ohio, are in active operation, with good orders and active inquiries. The rolling mills are running double turn.

Two large new boilers have just been set at the Russell Mills, in Chiltonville, Plymouth, Mass., replacing a pair which have been in use for twenty-two years.

Lucius Brigg's Son & Co., have remodeled the interior of the cotton mill at Haydenville, Mass., besides enlarging the main building and putting in new machinery.

The Orange (Mass.) Gold Medal Sewing Machine Co. have broken ground last week for an addition to the new shop, which is to be 130 feet long, 50 wide, and two stories high.

The Pennsylvania Railroad Co. have put a 40,000 pound steam shear into their shops at Altoona, Pa., where it will be used for cutting old steel rails, which are there converted into car wheels and other castings.

Ground has been broken for the new Wrampelmeier factory, at Louisville, Ky. It is to be five stories high, with a front of 200 feet, and the contract calls for its completion within three months.

The Perry Safety Car Coupling Co. is a new Chicago, Ill., enterprise, which has just been licensed to organize, with a capital of $28,000.

The Holyoke, Mass., Water Power Company have received from the mill engineers the plans of their new establishment, just being built on Cabot Street. The principal structure will be four stories high, and about 350 by 75 feet in size. The lower floor will be let for one concern, it is thought, the second will be divided into rooms for small manufactories, and the arrangement of the upper two will be decided upon when they are let. The buildings will be heated with steam, and a steam engine of 500 horse-power will be put in.

The Old Colony Iron Works of Taunton, Mass., have built an addition to their office.

The owners of a large manufacturing establishment in Connecticut, the nature of whose business is not disclosed, are now in this city looking for a location on which to establish their works. They have about decided to locate in Lakeview.—*Chicago Industrial World.*

It is announced that the Brotherhood of Locomotive Engineers will meet in convention, in Chicago, September 13.

Nearly all our manufacturing establishments, large and small, says the *Pawtucket* (R. I.) *Gazette and Chronicle*, are running on full time, and with some it is difficult to keep ahead of their orders. One great want is the lack of skilled machinists. The lull in business during the past few years led numbers of good machinists out of work to seek other means of livelihood. Apprentices (so called) were not needed, hence the lack of help at the present time.

A railroad is to be built along the abandoned Genesee Valley canal, connecting Rochester with Pittsburg, Pa.

Work on the New York, West Shore and Chicago Railroad is progressing. The great work of the undertaking is the tunnel being cut through the rocks at West Point. This tunnel will be about 2,700 feet long, twenty-seven feet wide and twenty-one feet high. It will require the excavation of 55,000 or 60,000 cubic yards of solid rock. About 10,000 cubic yards have already been taken out. This makes the work just about one-sixth done. There are at present over one hundred men at work on the tunnel. One-half work by day and the other by night. The electric light is used for the night work.

The Miller Co., Canton, O., are fitting up a new iron foundry, and are about to bring out a new model boiler.

A cable dispatch says the little steam yacht Anthracite arrived all well at Falmouth, Sept. 13th, being 23 days from Philadelphia. She started with 25 tons of coal on board, and could not have obtained any more. Part of this was used for the daily cooking for twelve men. No advice has reached here yet as to how much coal she had left.

Governor Cornell, C. M. Titus, of Ithaca, and John W. Halstead, of Rome, N. Y., have prepared papers to incorporate "The Ithaca Company," with a capital of $15,000. The company expects to manufacture sundry articles of use and ornament out of metals, glass, ivory and a composition, and perhaps make buttons. It is said when the business is developed it will employ 300 persons.

The Innis Manufacturing Company, of Oil City, Pa., are engaged in the manufacture of stationary engines, of which a great many are used for oil well purposes, and for boring artesian wells, throughout the United States and Europe. They have lately filled large orders for Russia, Germany and Italy, and by reason of increase of business, are enlarging their works so as to supply the pressing demand. They have just commenced working in their new foundry in which they have a new 48 inch cupola, a new 40 foot crane, and all the other conveniences necessary to make a foundry complete.

Articles of association were filed at Burlington, Ia., Sept. 1, of the Southern Iowa & Nebraska Railroad Company. The capital stock is three millions. The incorporators are officers and others interested in the Chicago, Burlington and Quincy Railroad. The new road is to be built immediately, and will start from a point near Hummiston, Wayne County, and run west through the southern tier of counties to the Missouri River to a point near the Iowa and Missouri state lines.

A new system of railway administration is to be tried in Russia. A sub-commission which was appointed to inquire into the working of the railways in the Empire have recommended the establishment of a railway congress, and the Czar has approved the plan. It is to consist of 150 members, representing the government, the railways and the patrons of the latter. To this body are to be referred all questions of public import relating to the management and development of railways.

A fly-wheel weighing twenty-four tons, to accompany an engine for the Peoria, Ill., Grape Sugar Co., and cast in one solid piece, has recently been made in Milwaukee.

The *Engineer*, of London, makes the following statement: "It is well known that to get from Sheffield firms a cast steel pinion without holes in which the end of a lead pencil can easily be put, if not the finger, is very difficult indeed."

Machinists' and Engineers' Supplies.

NEW YORK, September 16, 1880.

Trade is good with all the supply establishments. Prices are well maintained but not as a rule advancing.

The Hancock Inspirator Co., of Boston, have brought out a new "Pop" Safety Valve for locomotive, stationary and marine boilers.

The Derby Expansive Bit is a new tool offered to the trade by Felix Chillingworth, New Haven, Conn. When not in use the cutter shuts into a recess like a pocket knife and being knurled on the back will not creep or slip when used in boring. There are two sizes. No. 1 bores from ¾ to 2 inches and sells at $17 a dozen, No. 2 bores from ⅞ to 3 inches and sells at $26 a dozen.

The M. I. W. Tool Co., Milwaukee, Wis., are making a new twist drill which is very highly commended by machinists who have tried it.

The Union Manf'g. Co., New Britain, Conn., have just brought out Skinners' Independent Universal and Eccentric Lathe Chuck and have issued a circular giving prices, engravings and description.

H. Prentiss & Co., 14 Dey St., New York, are offering to machinists and the trade Barnes' New Open Die Plate, which is made entirely of steel. It is adjustable, and sells at $14.50 for No. 1 which cuts five sizes.

The Farmer Lathe Drill & Tool Co., Leominster, Mass., have issued a card price list of their new Universal Lathe Drill which they will mail to any machinist upon application.

Iron Review.

NEW YORK, September 16, 1880.

Pig iron is not in brisk demand, but prices are very well maintained. We quote No. 1, $26 to $27; No. 2, $23, and forge $21. Scotch pig is somewhat listless at $22 for Eglinton, and $24 to $25 for Coltners, Glengarnock and Gartscherrie. Manufactured iron is rather more active than pig, with prices steady.

Pierson & Co., 24 Broadway, N. Y., under date of Sept. 16, 1880, quote prices out of store as follows: Iron Rails, $50 to $53, according to weight; Fish Plates, 2¾c. per lb.; Railway Spikes, 3¼c.; Bolts and Nuts, 3½c.; Common Bar Iron, 2.4c., basis from store; Refined do. 2.6c., basis; Ulster, 3.6-10c. basis; Machinery Steel, 6½c.; Best Tool Steel, 13½c.; Norway Bar Iron, 6¼c.; Norway Shapes, 6¾c; Nail Rods, 6¾c.; Sheet Iron, 3½c., basis; Angle Iron, 3¼c.; Tee Iron, 3¾c.; Band Iron, 3.4c.; Hoop Iron, 3.6c., and up according to size; Horse Shoe Iron, 3.5c.; Hot Polished Shafting in lengths, 2 ft. and longer, 9 to 10½c., according to size; Small Black Rivets, 30% off in papers; 10% off in bulk.

Carmichael & Emmens, 130 Cedar St., New York, quote prices of Boiler Makers' Supplies from store as follows:

Flange Iron	5½
C. H., No. 1, Shell Iron	4½
C. No. 1 Iron	4¼
Tank Iron	4
Sheet Iron	3¾
Angle Iron	3½

Boiler Tubes at 40 per cent. discount off list.

Metal Review.

LUCIUS HART & CO., 8 & 10 Burling Slip, New York, furnish us the following, under date of Sept. 16, 1880:

The conditions remain very nearly the same as they were one week ago; the jobbing demand good, but, in the absence of large transactions, no advance as yet in prices, which, nevertheless, is generally expected. We quote Malacca and Straits tin, 20½c., futures, 21c. Singapore and London unchanged. Banca tin, 25c. Australian, Billiton and English, refined, 20 to 20¼c. English L. & F., 19¾c. Pig Lead, 5¼c.: Antimony, 16c. to 17c., according to brand. Spelter, "Bertha," pure, 8½c.; Silesian, 6c.; Western, 5½c.; No. 1 Solder, 11½c.; "Half and Half," 13½c.; Bismuth, $2.50 to $3.00.

WANTED.

Wanted.—A thorough, energetic, practical mechanic and draughtsman, or superintendent of foundry and machine works, employing 70 hands on engine, saw and grist mill, and plantation work, and jobbing, and repairs. State what kind of work familiar with, and pay, and all particulars. Address Geo. R. Lombard & Co.. Augusta, Ga.,—refer to Wm. Cooke, machinery and supplies, 6 Courtlandt St., N. Y.

Foreman wanted for an iron foundry doing all kinds of machine work. To a competent man a good salary and steady employment. Address "Foundry," care of Morse Burtis, 76 John St., New York.

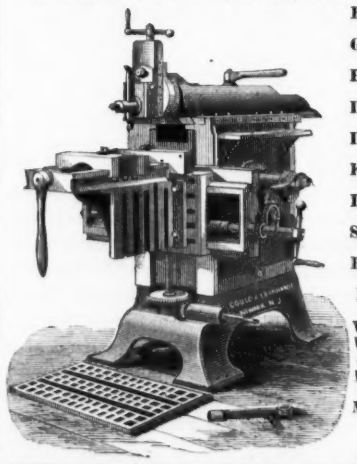
A Steam Engineer who is thoroughly familiar with the business of heating with steam and hot water, would like to correspond with some iron working establishment in the West with a view of going into that business. Address, Engineer, Box 1338, Boston P. O.

An experienced machinery iron works Superintendent wishes to engage with reliable parties. Address, P. H. L., care AMERICAN MACHINIST office.

Wanted.—A Superintendent for a foundry and machine works now employing 67 hands. State class of work been accustomed to, and reference fully. Address Geo. R. Lombard & Co., Augusta, Ga.

A. ALEX. POOL & CO.
NEWARK, N. J.
Manufacturers of
Combined Lathes and Milling Machines
FOR TOOL MAKERS' USE, also
Universal Milling Machines, Grinding Machines.

E. GOULD & EBERHARDT,
97 to 113 N. J. R. R. Ave., Newark, N. J.



Builders of Lathes, Shapers, Planers, Drills, Bolt Cutters, Gear Cutters, Power Presses, Drawing Presses, Drop Presses, Foot Presses, Lever Presses, Screw Presses, Bank Note Printing Presses, Mortising Machines, Special Machinery and Machine Work in General.

WILLIAM COOKE,
(Successor to COOKE & BEGGS,)
6 Cortlandt St., New York,
SELLING AGENT FOR
ROOTS' NEW IRON BLOWER.

POSITIVE BLAST.
IRON REVOLVERS, PERFECTLY BALANCED
IS SIMPLER, AND HAS
FEWER PARTS THAN ANY OTHER BLOWER.
ROOTS'
Blacksmith's Hand Blowers,
Portable Forges, and Tuyeres.
SEND FOR PRICE LIST.

GEO. W. FIFIELD,
Manufacturer of ENGINE LATHES from 16 to 48 in. swing. Cuts, Photographs and Prices furnished on application.
LOWELL, MASS., U. S. A.

Mechanical Books.
Send 10 cents for 96 page Catalogue of Books for Machinists and Engineers.
D. VAN NOSTRAND,
23 Murray & 27 Warren Sts., New York.

STEPHENS' PATENT PARALLEL VISE and attachments, adapted to every variety of work from Jewelers' to Locomotive Shops. It opens further, holds firmer, is heavier and more durable than any other vise. For sale by the trade.
Stephens' Patent Vise Co.
41 Dey St., New York, U. S. A

C. W. LeCOUNT,
South Norwalk, Connecticut,
Manufacturer of
LeCount's Improved Steel Dog

With hardened Steel Screws turned in the Lathe.

PRICES.

No. 1....	¼	in...	$ .40
" 2....	½	"	.50
" 3....	¾	"	.60
" 4....	1	"	.70
" 5....	1¼	"	.85
" 6....	1½	"	.95
" 7....	1¾	"	1.10
" 8...	2	"	1.20

SMALL SET, $6.30.

No. 9...	2½	in....	1.40
" 10..	3	"	1.60
" 11...	3½	"	1.80
" 12...	4	"	2.00

FULL SET, $13.00.

TO LET.
The whole or part of the finest building in Brooklyn. 75x100 feet, four stories high, and splendid high, dry cellar, with the best of light, only one block from the New York Ferries, on a corner, near the depots of all the main trunk lines of Railroads to the North and West.
The very best chance for a Manufacturing, Printing, or Publishing business near New York. Will be let with or without steam, which can furnish, if required, to 100 Horse Power.
Will be let low to right parties.
Address "BUILDING,"
Brooklyn, E. D., P. O., New York.

AKRON IRON COMPANY,
AKRON, O.
SOLE MANUFACTURERS OF
Patent Hot Polished Shafting.

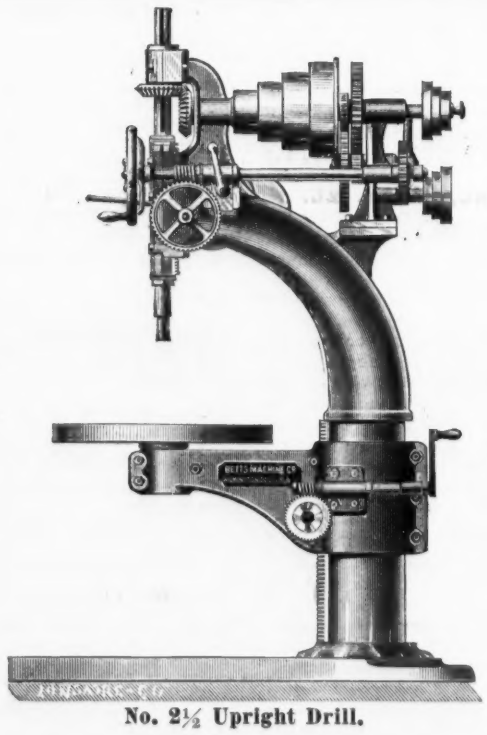
This shafting commends itself to the trade generally as superior to any shafting ever before introduced to the market for the following reasons, viz.:

1st.—It is perfectly straight and round.
2d.—It can be rolled accurately to any desired gauge.
3d.—It has the beautiful blue finish of Russia Sheet Iron, rendering it less liable to rust or tarnish than shafting of the ordinary finish.
4th.—It will NOT SPRING OR WARP IN KEY SEATING like most of the other manufactured shafting sold in the market, and, as a consequence, is admirably adapted for LINE AND COUNTER SHAFTING.
5th.—The surface is composed of MAGNETIC OXIDE OF IRON, forming a superior journal or bearing surface.
6th.—It is made of superior stock.

Price lists, with references and other information, furnished on application to us.

Or to our Agent, AKRON IRON CO., Akron, Ohio.
E. P. BULLARD, 14 Dey Street, New York City,
General Agent for N. Y. City and other Eastern States.

BETTS MACHINE CO.
WILMINGTON, DEL., U. S. A.
MAKERS OF ALL KINDS OF
HEAVY MACHINE TOOLS



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SOLE MANUFACTURERS OF

FILES AND RASPS

HAVING THE INCREMENT CUT.

Also, FILERS' TOOLS and SPECIALTIES.

"Nicholson File Co's" Files and Rasps.
"Double Ender" Saw Files.
"Slim" Saw Files.
"Racer" Horse Rasps.
Handled Rifflers.
Machinists' Scrapers.
File Brushes, File Cards.
Surface File Holders.
Vice File Holders.
Stub Files and Holders.
Improved Butchers' Steels.

Manufactory and Offices at PROVIDENCE, R. I., U. S. A.

NEWARK STEEL WORKS.

BENJAMIN ATHA & CO.

MANUFACTURERS OF

CAST STEEL

WE MAKE GRADES OF STEEL SPECIALLY ADAPTED TO THE MANUFACTURE OF LATHE TOOLS, CHISELS, TAPS & DIES

BENJ. ATHA. NEWARK, NEW JERSEY. J. ILLINGWORTH.

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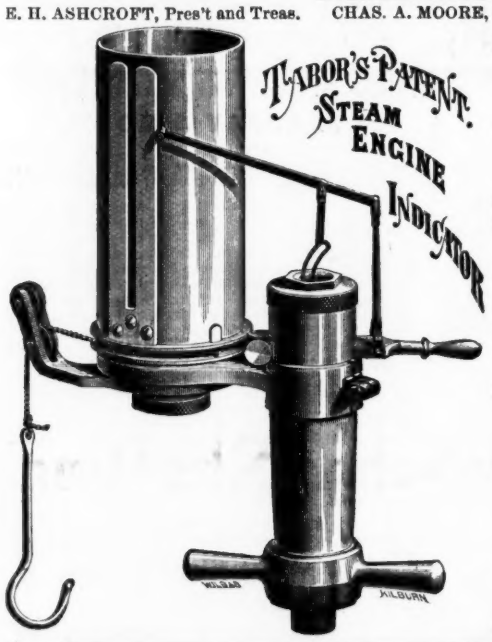

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Successors to E. H. ASHCROFT,

"Original Steam Gauge Works."

THE E. H. ASHCROFT

Improved "Bourdon" Steam Gauges,

Sole Owners and Manufacturers of

TABOR'S PATENT

STEAM ENGINE INDICATORS,

Specially adapted to

Indicating High Speed Engines & Locomotives

STEAM AND WATER GAUGES,

Railway, Steamship & Machinery Supplies

WAREROOMS:

Nos. 51 & 53 Sudbury St., and
8, 10, 11, 12 & 14 Bowker Street,
BOSTON, MASS.

Factories, BOSTON and LYNN.

GEO. H. BARRUS,

EXPERT ENGINEER,

87 MILK ST., BOSTON.

May be consulted on matters relating to the generation and use of STEAM and the arrangement of New Works.

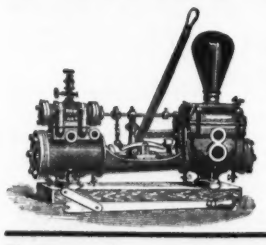
Expert Tests

made on ENGINES, BOILERS, and STEAM PUMPING MACHINERY.

KNOWLES' IMPROVED STEAM PUMPS,

THE STANDARD!

Steam Pumps for Every Possible Service.



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86 Liberty Street, NEW YORK. | *44 Washington Street,* BOSTON.

Drawing Instruments

AND MATERIAL, PAPER, &C.

G. S. WOOLMAN,

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Fully priced and illustrated Catalogues.

RALPH R. OSGOOD'S BOOM DREDGE.

Adapted to all kinds of under-water excavation. Guaranteed to excavate 50 per cent. more material from hard bottom than any other machine made, all things being equal. Illustrative pamphlets, comparative strain sheets and estimates furnished on application. ☞ See AMERICAN MACHINIST of July 31, 1880. Address

RALPH R. OSGOOD, Troy, N. Y.

☞ When in New York City will be 81 Astor House.

KEARNEY & FOOT

Office, No. 78 Chambers Street, N. Y. | Full Weight Hand-Cut Files. | Manufactory, PATERSON, N. J.

The best and cheapest in the end. Send for quotations. The files speak for themselves in the following testimonials. Read them.

NORTH RIVER IRON WORKS.

TO WHOM IT MAY CONCERN: New York, May 1st, 1877.

We have used the Files made and re-cut by Messrs. WEINMANN & KEARNEY for the past three years, and we know of no better recommendation than the fact that we are still using them.

FLETCHER, HARRISON & CO.

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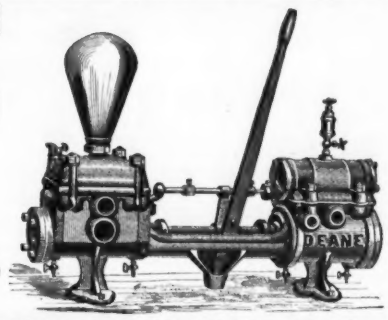

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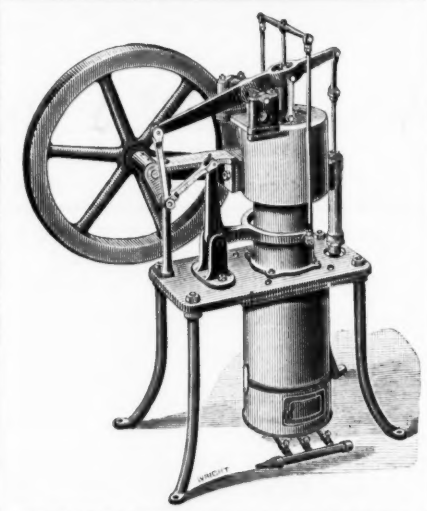

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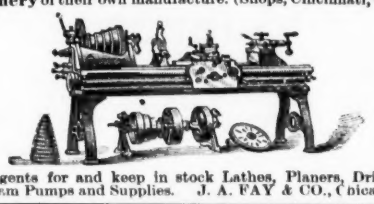

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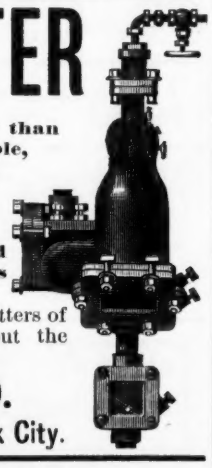

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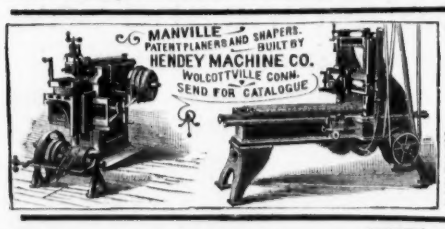

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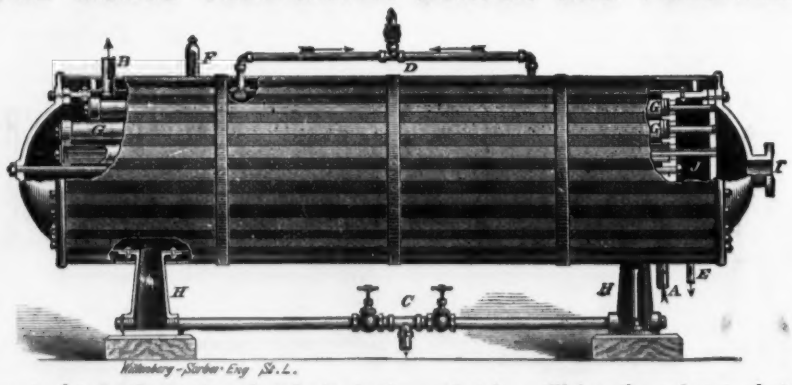

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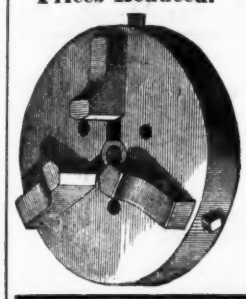

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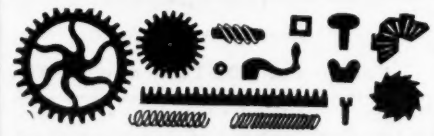

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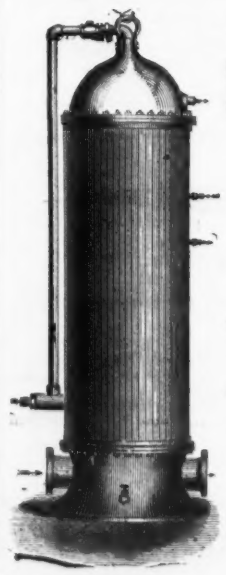

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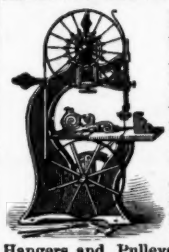

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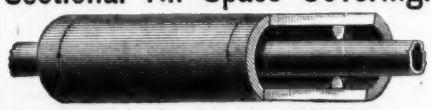

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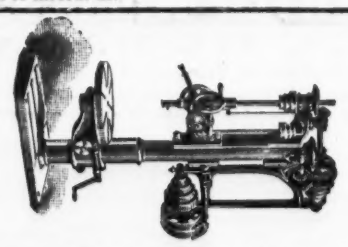

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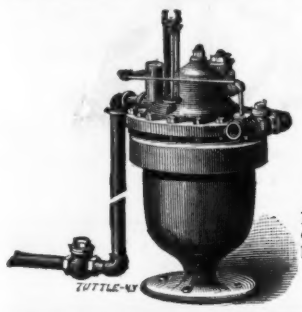

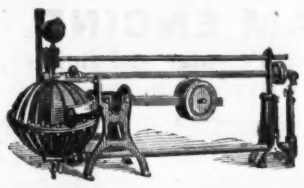

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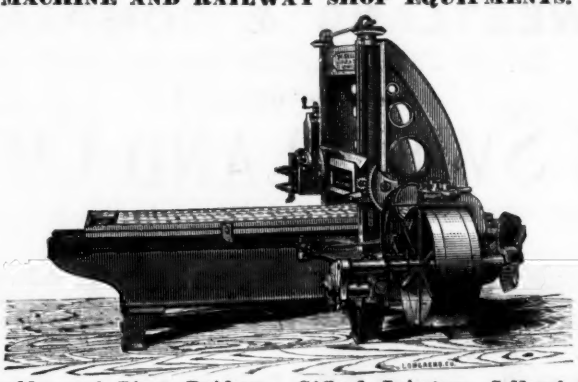

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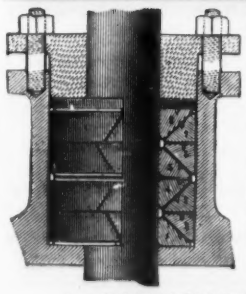

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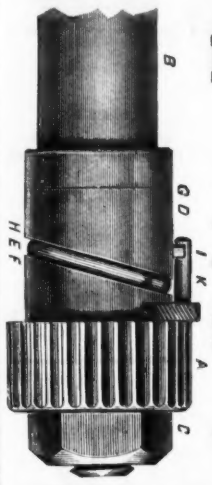

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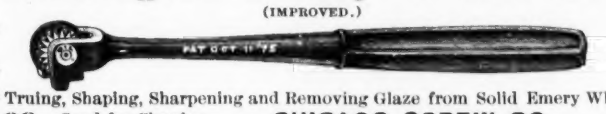

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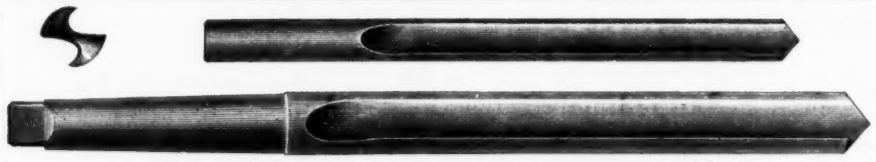

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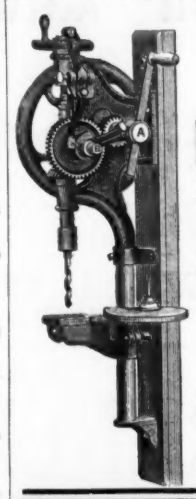

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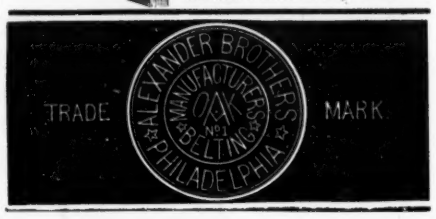

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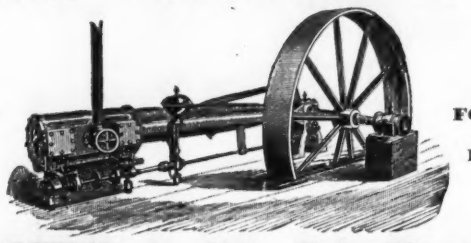

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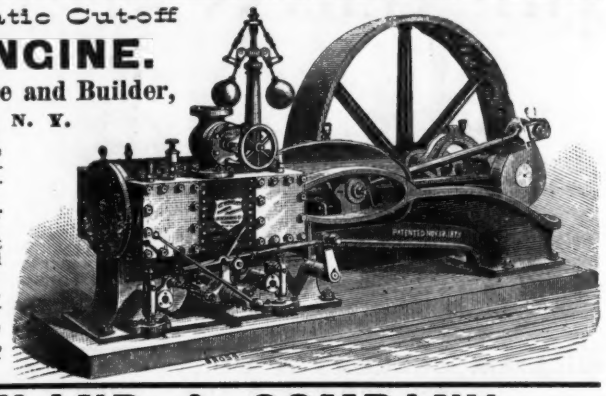

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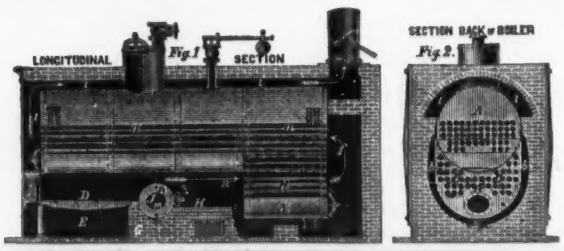

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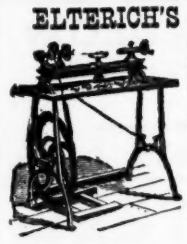

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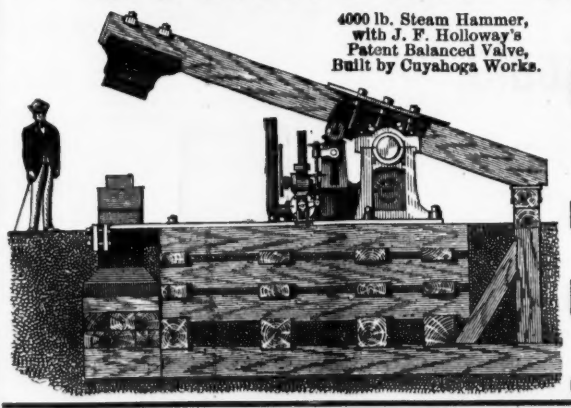

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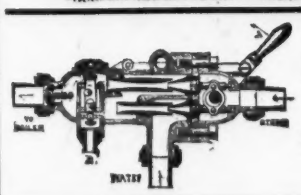

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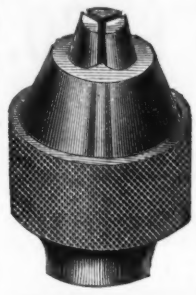

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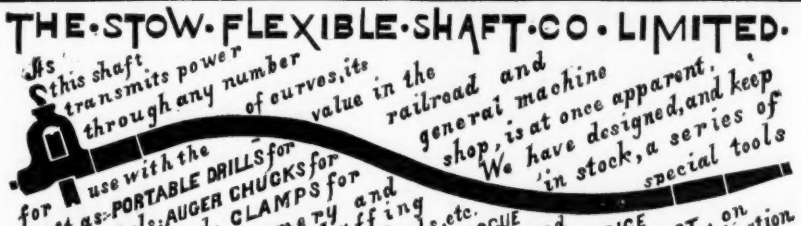
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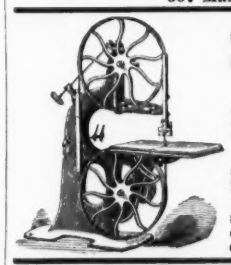

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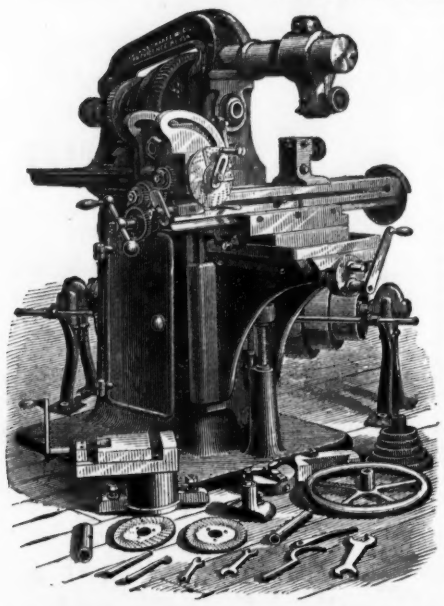

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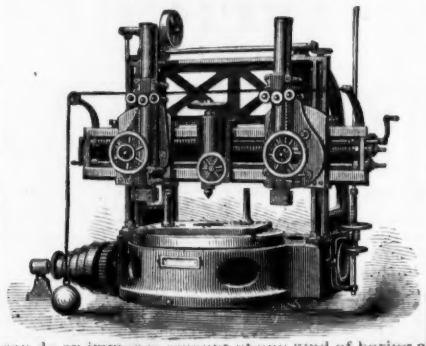

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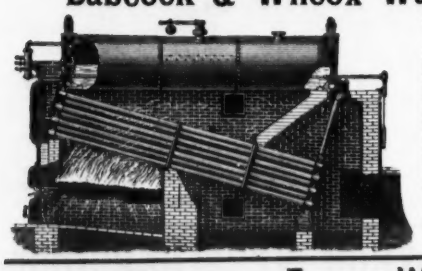

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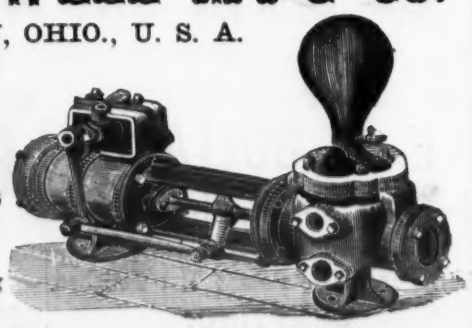

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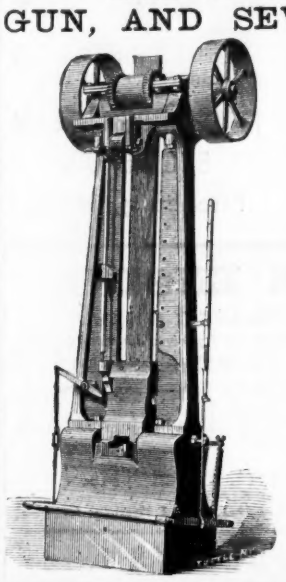

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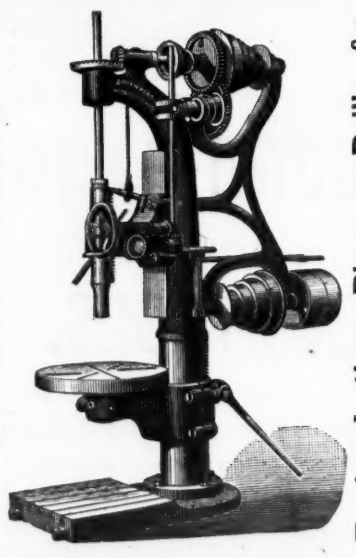

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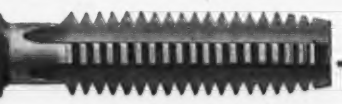

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